DYNAMIC FACTORS IN EDUCATION

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DYNAMIC FACTORS IN EDUCATION

BY

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TO

Leaton Irwin, Esquire

QUINCY, ILLINOIS

WHO FOR A NUMBER OF YEARS HAS GIVEN MOST GENEROUSLY OF HIS TIME, ENERGY, AND PRIVATE MEANS FOR THE IMPROVEMENT OF THE PUBLIC SCHOOLS OF HIS NATIVE CITY, IN RESPECT PARTICULARLY TO THE MATTERS DISCUSSED IN THIS VOLUME. THE AUTHOR IS FIRMLY CONVINCED THAT AMERICAN EDUCATION TO-DAY STANDS IN NEED, ABOVE EVERYTHING ELSE, OF LAYMEN WHO WILL ACQUAINT THEMSELVES WITH CONTEMPORARY EDUCATIONAL IDEALS, AND WHO WILL COOPERATE ENTHUSIASTICALLY WITH EDUCATORS IN SECURING THE MATERIAL EQUIPMENT AND SOCIAL SANCTION ESSENTIAL TO GET THESE IDEALS REALIZED IN EVERY COMMUNITY.

PREFACE

One does not have to go back very far in order to reach the time when such terms as "motor activity," "dynamic education," "fatigue," and the like were quite strange to educational literature. It was not then thought that teachers should concern themselves with the matters denoted by these terms. It was their business to "train the mind," to "fashion character," to "develop thought," and to "awaken and nourish ethical feeling." The active side of child nature was little heeded, except to repress it, because it was not regarded as a vital or important phase of the "spiritual self." Similarly, while it was more or less generally appreciated that a sound body aided in preserving a sound mind, still it was believed that the spirit could if it would resist the ill effects of a depleted nervous system. Sufficiently aroused, it could overcome all unfavorable material influences, and keep the mind keen and ready and the heart pure and well-disposed even if the flesh were weak.

But we are entering upon a new era for educational theory. Some among us are saying that the dynamic side of human nature is the really important thing to

be looked after in the schoolroom, and outside, too, for that matter. I find myself in sympathy with the view that the motor and physical factors in teaching, should receive more attention than they now do in most places, and this will account for the appearance of the present volume. I have aimed to show herein, in the first part, that in the early years, at any rate, motor expression is essential to all learning; and I have endeavored to indicate, in outline mainly, how the requirements of dynamic education can be provided for in all departments of school work. I have sought to point out further that there is a definite order in which the motor powers develop, and that in our instruction we will achieve the highest success only as we conform quite closely to this order. In the second part of the book the relation between fatigue and activity is considered. On the one side the nature and causes of fatigue are discussed, and then the effects upon mind and body are traced. I have gone into considerable detail in pointing out ways and means of carrying forward the work of education without overtaxing the pupil.

Many, perhaps most, of the principles presented in this volume are, I think, becoming familiar to students of mental development, but they are still very hazy, to say the least, in the minds of the majority of those who are charged with the immediate care and culture of the young. So in the preparation of this volume I have kept in mind these latter persons, and have aimed to

avoid technicalities and all purely theoretical discussion. I have endeavored to show concretely the changes which take place with development in respect of various activities, and so it has seemed to me best to start back at the beginning in most cases. To get any just notion of the power of motor coördination, for instance, of a child of five or older, we must see what he can do at the outset when everything is comparatively simple; and then we must give an account of what happens as he moves on in his course.

It has been my purpose, in the first place, to summarize the investigations that have been made upon the different topics discussed. I have, of course, and often without special mention of the fact, constantly consulted the more important writers on Mental Development and Fatigue,—Preyer, Baldwin, Sully, Hall, Shinn, Moore, Perez, Mosso, Binet et Henri, and many others. Then it has been my aim further to give the results of my own observations in the schools and upon several children whose development from the beginning I have followed in detail for a number of years. These children have furnished me the largest number of my illustrations, which, I may say, I have tried to keep within reasonable bounds, contenting myself with one or two typical illustrations of a principle.

At the close of each chapter I have indicated a number of topics for investigation and discussion, which are designed to encourage the reader to make practical test

and application of the principles developed. It has been my thought that these topics would prove serviceable in study classes, and to the student working alone. For this reason I have sought to make every question and suggestion relate to concrete matters within the experience of most students and teachers, and with which they are concerned in their everyday work.

In the Bibliography I have indicated the general character of each reference, and where it has been referred to in the text, I have also suggested the classes of readers for whom it is best adapted. Throughout the text I have referred to the most important book and periodical literature treating of each topic considered, and it will be apparent in most cases, I think, what is the general point of view of any reference. It has seemed to me this would enable the student to choose his readings with greater definiteness than if lists of books had been given at the close of each chapter.

The substance of some of the paragraphs in the second part of the book appeared originally in a Bulletin published in the Science Series of the University of Wisconsin, but the matter is here presented from a new point of view.

M. V. O'SHEA.

MADISON, WISCONSIN,
October, 1905.

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PART I

THE MOTOR FACTOR IN EDUCATION

CHAPTER I

THE DEVELOPMENT OF INHIBITION

Children's lack of inhibition.

It is a matter of common remark that the typical child gives way easily to his feelings. His tears flow freely upon the slightest pretext; he becomes hilarious over mere trifles; he gabbles incessantly when he ought to maintain silence; he flies into a passion whenever he is crossed; and so one might go through with a long list of excesses. Judging from what one hears and reads, the chief problem of most parents perhaps is to restrain these annoying expressions of the young. How frequently a mother says of her boys, "They will drive me to distraction." Compared with ourselves our children seem impulsive, willful, heedless. They struggle with almost malicious persistence to carry on their own enterprises regardless of the desires of their governors. A sensitive adult, or one who craves quiet, may expect little peace in the company of children from two to ten, say, who have been indulged in their spontaneity. They will be con-

tinually striving to perform tasks in emulation of th elders, for which they lack size or strength or ingenui and they will use every means at their command to secu help from those who can aid them. They will be ru ning here and there, jumping, climbing, pounding, thro ing, shouting, handling everything novel within reacl teasing one another and every living thing from whic they can get some reaction; in brief, a normal child i incessantly active in a muscular way, and much of thi activity is not in accord with the demands of his en vironment.

Literature, and especially that of our own day, the day of stories and sketches of the young,[1] is replete with references to the restless hands and feet of childhood.[2] Aristotle tells us that the child craves exercise of all his motor powers, and the same view in substance is taken by Plutarch, Quintilian, Rousseau, Locke, Pestalozzi, Froebel, Spencer, and their disciples. The characteristic of child life which stands out most prominently in

[1] What I have in mind here is the large amount of book and magazine literature about child life which has been appearing these past few years, — such as Graham's "The Golden Age"; Nesbit's "The Would-Be-Goods" and "The Treasure Seekers"; Martin's "Emmy Lou, Her Heart and Her Book"; and stories similar in general plan by Josephine Dodge Daskam, Stephen Crane, R. R. Gilson, Mary E. Freeman, Eden Phillpotts, Ruth McEnery Stuart, N. A. White, Rudyard Kipling, *et al.*

[2] There is some good philosophy beneath the mirth of such pictures of child life as Hood gives us in his "Ode to an Infant Son," Habberton in his "Helen's Babies," and the like.

the testimonies of modern students of the subject, such as Preyer, Dewey, Baldwin, Compayré, Sully, Hall, Moore, and many others is motor activity. They all find that the infant tends to be continually in action during most of his waking moments. As Baldwin puts it,[1] ". . . the child acts, and act it must, on the first suggestion which has the faintest meaning in terms of its sensations of movement." Mr. Bell has kept a record of the activities of his two children for a single day, and a paragraph or two from his report may help to impress the point here under consideration. He says,[2] speaking of the speech activity of a normal five-year-old for one day: "When I counted the total number of words which the child had used, I was not surprised to find them footing up to 14,996.

"On July 8th, just one week later, a similar observation was made upon the younger child. Her record for the day was a total of 15,230 words. Numerous observations conducted upon different children for shorter periods lead me to the conviction that these records are not exceptionally large.

[1] "Mental Development, Methods and Processes," p. 5.

[2] *Independent*, Vol. 55, p. 911. Compare with Mr. Bell's record the observations which Mr. Dresslar made upon his child during a half day, — *Ped. Sem.*, December, 1901, pp. 469–481. Here is one sentence from his conclusions: "External stimulus is immediately answered by motor activity, even though at first these responses are uncontrolled and purposeless." (Reprint, p. 12.)

"As to the other activities involved in the day's record, I wish to say that although I followed each child about the house, barn, yard, garden, sidewalk, across the street to playmate's yard, swing, sandpile, etc., I went through fewer than one fifth of the number of movements of body, legs, arms, hands, feet, head, which the child under observation went through."[1]

The effect of motor restraint on mental activity.

Shut a boy up in a room to keep him out of mischief, and if he has no opportunity to climb or to use the furniture for constructive purposes, or to use his hands in any way in making or drawing or destroying, then his energies will escape through his vocal organs, or he will simply pound on the floor or walls or turn somersaults. Should these latter activities be repressed, he will in due course fall asleep. An adult could content himself, or at least busy himself, with *thinking*, but not so with the five-year-old. "Before fifteen is the time for action; after this will be time enough for reflection" — so nature

[1] Holmes has studied child nature, and he asks us to observe how the boy "loves to run, swim, kick football, turn somersets, make faces, whittle, fish, tear his clothes, coast, skate, fire crackers, blow squash 'tooters,' cut his name on fences, read about Robinson Crusoe and Sinbad the Sailor, eat the widest-angled slice of pie and untold cakes and candies, crack nuts with his back teeth and bite out the better part of another boy's apple with his front ones, turn up coppers, 'stick' knives, call names, throw stones, knock off hats, set mousetraps, chalk door-steps, 'cut behind' anything on wheels or runners, whistle through his teeth, 'holler' Fire! on slight evidence, run after soldiers, patronize an engine company, or, in his own words, 'Blow for tub No. 11.'" — *The Professor at the Breakfast Table*, p. 224.

seems to say. One rarely detects children of a tender age deliberating upon a situation; he always finds them dynamic with reference to it. By eight, perhaps, this tendency to reflect, which means to review one's experience with situations resembling that which now confronts the individual, and which summons him to action of some sort, — by eight, possibly earlier in some cases and later in others, this tendency is beginning to be manifested; and it continues to gain in prominence and importance until maturity is attained. Development means, in large measure, the acquisition of experiences which in considerable part function inhibitively upon original impulses and tendencies to immediate reaction upon stimuli. Bagley[1] expresses this view in other terms when he says that education is "the process by means of which the individual acquires experiences that will function in rendering more efficient his future action."

At the outset the child acts largely for the pleasure of action as an end in itself, though the desire to excel and the joy in being a cause doubtless play a part in all his activities. When children begin to use a hammer, for instance, they pound away, not with the aim of making anything in particular, or even hitting a nail. The consciousness of being able to direct the hammer upon a box, or the floor even, is sufficient reward in the beginning. Try to get a child of three, say, to confine his pounding to

[1] "The Educative Process," p. 22.

driving nails, and you will find he is not ready for such specific and coördinated, or better *differentiated*, action. The aim of *making* something, of *achieving a definite end in his action*, cannot yet control his spontaneity to any marked extent. His muscles at this stage of development have a certain measure of independence and initiative; they have not yet become the obedient servants of the mind. In the course of development, ends which the individual desires to attain will come to determine all his activities; mere spontaneous muscular action will become subordinated to ideas, speaking in current phraseology; but it is otherwise at the start.

Restraint comes with development. One who has observed children even casually must have noticed that as development proceeds the period during which motor action may be and habitually is restrained is gradually increased.[1] From five or six years on, children who have the opportunity spend a considerable part of their time in hearing and reading stories and enjoying pictures; and they may even sit quietly in their seats and "learn their lessons." It is probable, though, that the mental states established by a story or a picture tend to become realized readily in appropriate action. The whole

[1] Of course, children differ greatly in the rapidity with which they develop inhibition. V., a boy, is much less restrained at seven than H., his sister, was at that age. The so-called motor type of person does not acquire inhibition as readily or as completely as the so-called sensory or mental type. Cf. Baldwin, "Inland Educator," Vol. II, pp. 126–129; Vol. III, pp. 232–235.

organism is doubtless affected in characteristic ways, at least by those parts of any story that depict vital situations, regarded from the child's standpoint. A situation would not be regarded as vital if there were no marked organic effects produced in contemplating it. Feré[1] maintains that the whole body "thinks" when the brain is in action. Contemplation at any rate implies more than seeing or hearing or imaging in a narrow sense; it implies that the child gains an appreciation of what the eye and ear give, and what images mean, because of certain effects which these exert upon vital function. In telling H., during her fifth year, the story of Bluebeard, I could observe that her respiration was always affected at the tragical moments. Her muscles became rigid when I reached the place where the door was opened into the secret closet, and we got a sight of the remains of the women who had been killed there. And this is typical, I think, of much that may be observed in childhood, if one will look for it. With development this organic response, like so much else in human nature, gets subdued, checked down, generalized perhaps, but it probably never wholly disappears.

As soon as children begin to appreciate a picture or interpret the language of a story they try to "act out" more or less completely what they see and hear. Tell a child of three or four the story of the Three Bears, and he will be likely to growl as he imagines they do; he will show

[1] "Sensation et Mouvement," p. 25.

you how Silver Hair ran, how the bears ate the porridge, and the like. So he will bark like the dogs in his stories, puff like the steam engines, run on all fours as the cats and other quadrupeds do, and so on *ad libitum*. I could not mention a dog in any connection in the presence of S. when he had reached his nineteenth month without his barking and otherwise exhibiting the behavior of the animal as he had had experience with it, either actually or in the representations of his elders. So any allusion to a steam engine would not fail to set his arms and legs and lungs in motion after the pattern of the engine, as he thought. I have many notes relating to the manner in which a group of young people reacted upon such a word as "jump" in a story concerning children, or even animals, in play. Though they might apparently be attending in other directions when they heard it, they would nevertheless often wish to show me how it was done. It is probable that appreciation always involves more or less complete execution in the beginning; but with development the motor processes, in dealing with many familiar situations, decline; and the same is true of the distinct conscious processes. Development always secures abridgment or condensation of the detailed processes in all oft-repeated experiences.[1]

[1] I have worked out this thought further in my "Education as Adjustment," Chap. XI. See also Bagley, *op. cit.*, Chap. IX, and Judd, "Genetic Psychology for Teachers," Chap. II.

It should be recognized in this connection that those words only will set up marked motor responses in children that relate to activities which they are learning, or perhaps practicing at the time. When they get certain adjustments thoroughly mastered they seem not to be so eager to rehearse them except when the needs of adjustment demand it. Or possibly there may be a momentary impulse to act them out, but other interests have become more important and prevent the attention from remaining on the old familiar actions. The energy may be drawn off into other channels that represent newer acquisitions. This doubtless accounts for the phenomenon observed by Münsterberg and Campbell,[1] that the motor power of ideas decreases with the lapse of time. But the point to be impressed here is that a child will actually perform those activities which at the time are of supreme interest to him, which he is striving to possess himself of, if they be suggested in his stories or his pictures. It is worthy of note that children from the second year on for several years will allow no one to relieve them of doing anything relatively novel. They insist upon feeding themselves, dressing themselves, making their own playthings, opening all packages that come to the house, and so on. When any of these processes have become thoroughly mastered, though, there seems to be less desire on the part of the

[1] See "The Motor Power of Ideas," *Psych. Rev.*, 1894. Vol. I, pp. 441 ff.

child to continue to perform them. At six or thereabouts he is willing and even anxious to have some one button his shoes and clothing, cut his meat, run errands for him, and the like.

Is it possible that the principle here in question is operative at every stage of development? Do adults practice actions in which they are genuinely interested, or which may be those they are *learning?* We are not greatly impressed with this tendency in mature life, because we have lost real, vital interest in all the ordinary activities suggested to us by our reading and our art. These activities can for the most part be performed easily, perhaps subconsciously, and it is of no advantage for us to practice them, for the sake merely of making their execution certain and facile. But take an adult who goes to live for a time in a strange country where the manners of the people are more or less novel, and he desires to adopt them as soon as possible — will he tend to rehearse these manners whenever he reads of them or sees them performed? One who goes to study at a German University, for instance, will for a time be more or less eager in "trying on" the peculiarities of German student life. The customs of the people will occupy a relatively important place in consciousness, and they will easily get possession of the motor routes. This is, of course, the only way in which he can become adapted to his new environments. The habits of his former life will not fit into his new surroundings, and so consciousness is

called in to inhibit the old processes and establish new ones.[1] These latter will be repeated until they may be depended upon, when they will be given over to the control of suggestion. This principle is well illustrated in an adult learning to speak a foreign language. He keeps vocalizing the new words he hears until their execution becomes largely automatic, when he ceases to practice them.

One may gain a useful lesson if he will read Kipling's "Jungle Book," say, to a group of children ranging from four years to nine or ten, and observe their reactions. The younger children will probably be constantly imitating the simpler actions mentioned, while the ten-year-olds will listen, as we say, keeping motor reaction in check more or less completely, as though they were organizing the images being gained now with others which they have gained from other stories. They have doubtless passed, to a certain extent, the barking and growling and crawling and jumping and climbing and scratching periods. It is as though the various organs and muscles involved in these activities had learned how to perform them, and had no object now in practicing them.[2] Energy must be saved

[1] This is, I think, becoming a familiar notion in modern psychology. For a recent presentation of the view, see Dewey, *et al*, "Studies in Logical Theory"; Angell, "Psychology"; and "Habit and Attention," *Psych. Rev.*, Vol. III, pp. 245 ff. and Vol. V, pp. 179 ff.

[2] Russell, in his "Imitation and Allied Activities," gives a large number of instances illustrating the general principle in question here, — the change which takes place with development in the child's mimetic activities.

for drilling on the activities that are new. It would not be quite right, though, to say that the older children did not react at all upon the stories. After the reading they will probably dramatize the principal scenes, personating the animals mentioned, and behaving as they think proper in their assumed personalities. They are interested now in working out the jungle situation as a hole, rather than in the performance of simple activities as single and isolated acts.

If we pass on from the ten-year-old to the college student we shall find that the latter will attend to the story; and while there may be motor reverberations throughout his organism, still there will be little manifested outwardly, as in the personation of a lion, for instance. The college student has, through past experience, gained an appreciation of the jungle situations through imitating them, and he is not now incited to try them. His organism has at the appropriate time taken on the forms of jungle life; and now it must be concerned with getting the feeling of new forms of political, social, and religious life presented in his environment. The college student is learning through imitating and dramatizing just as is the grammar grade student, only he is concerned with relatively very complex social activities. He has his circle of interests, as has the child, wherein he is practicing activities that are of vital import to him, because they are required for complete adjustment to his social environment.

The neurological view of inhibition.

Considered from the neurological standpoint, inhibition of an action is secured mainly by using up in other ways the energy which is needed for its support. An individual will then acquire the power to restrain certain actions according as he develops new ways, either motor or mental, of utilizing his forces.[1] At the outset his possibilities are so limited that action occurs within a very circumscribed area. And if he cannot employ his energies fully in accomplishing simple motor tasks of some kind, he will become "restless." Ask a child of four or five years to sit perfectly still and fold his arms. Try as hard as he may he will nevertheless soon begin to move around in his seat, or swing his legs, or he will at least show unusual muscular tensions in his face and arms and body as a whole. When lively children are commanded to sit perfectly still, automatic movements of head, face, eyes, hands, legs, mouth, and shoulders may often be noted after several minutes of effort. In the case of V. at five some of these automatisms would usually appear after a very brief period of trying to restrain all motor activity. H. and S. could endure the tension for a longer time, but even they showed considerable disturbance after a few minutes of constraint. Curtis[2] declares that children of four cannot inhibit all activity for the space of a minute; but older children can restrain themselves for a

[1] Cf. Royce, "Outlines of Psychology," pp. 70–80.

[2] See his "Inhibition," *Ped. Sem.*, Vol. VI, p. 93.

somewhat longer period, depending in part upon age, and in part upon individual capacity.

In general it may be said that the less elaborate the mental processes the greater the proportion of energy that will escape through motor channels; while the more elaborate the mental processes the more completely will the energies be utilized in thinking, speaking popularly.[1] It is a question primarily of the manner of utilizing nervous energy.[2]

[1] Cf. McDougall, "Inhibition," *Brain*, Summer, 1903, pp. 153–192. Also James, "Talks to Teachers," etc., Chap. XV; King, "Psychology of Childhood," Chap. IX; and Warner, "The Nervous System of the Child," Chap. X.

[2] "In the lower animals, every feeling or idea has an immediate motor expression which gets executed to a greater or less degree. In man many of these expressions fall short of complete execution. They are suppressed, and we are able to trace them, or find their existence only in rudimentary form — in mere tendencies to act. Civilization and culture tend to modify and refine the expression of the motor innervation accompanying thought. In the child the natural and direct expression of its thoughts are least repressed, spontaneity is greatest; gradually, however, as the simplicity of its mental life develops into more manifoldness and complexity there is a general leveling tendency manifested in the motor expression of ideas. At the same time there is an increase in the number, variability, and accuracy of motor expressions. This increase is parallel to the development of consciousness. In terms of brain physiology this repression of outward and visible expressions may find its explanation in the increased number of associated centers, whose activity means the transference of stimuli into a larger number of motor channels, thus modifying or even suppressing each other's action. In the child, before associations are formed to any extent, a stimulus may affect a small cortical area or a single center only. Later, when the center has formed connections with a number of associated centers, the same stimulus may call up through these centers various motor innervations which are

Inhibition, in the sense in which I am speaking of it, requires for one thing the draining of the motor areas to support activity in sensory and associative regions. This implies on the mental side that one can entertain ideas that do not relate directly and immediately to situations demanding motor reaction. A philosopher, for example, is attending so constantly to "abstract" matters that motor activity is almost entirely inhibited, at least for long periods at a time; though in the end it is possible his reflections may issue in some form of action.[1] Now, if the child of five could suddenly become possessed of the philosopher's range of attention he would be as suddenly transformed from a motor into a mental being. But nature does not work according to this method in the sphere of human development.

antagonistic, and so neutralize or modify each other. The more complex the mental side — *i.e.* the greater the number — and the more diversified the locality of simultaneously excited centers, the less are the chances for a direct and simple act." Breese, "On Inhibition," *Psych. Rev.*, Monograph Supplement, Vol. 3, 1899–1901, p. 61.

[1] I am not so confident as many in our day seem to be, that in the end all reflection leads to action in one's own life. It seems possible that some men may reflect, and others, perhaps their descendants, at any rate not themselves, may be guided by their reflections. Plato and Aristotle and Kant and Hegel were probably less influenced themselves in their conduct by their own reflections than have been some of the generations since their time. The social organism is so constituted that some of its members may give themselves to reflection, while others put their conclusions into execution. Doubtless the goal of all thinking is action; but it is not imperative for either individual or social well-being that the circle should be completed in any one individual life, or even in any one generation.

It is not to be supposed from what has just been said that the extension of the range of attention is a psychical matter pure and simple. You may place a child of three, say, in certain situations which set up complicated intellectual processes in your own case, but he may be quite unable to attend to the things which may engage your attention for a long period. To illustrate, I have often attempted to get very young children to attend to verbal forms which I would write on a blackboard or on a piece of paper, and which older children would "study" with much success. But while the three-year-old would follow me *while I was making* these forms, he could not attend successfully to the forms themselves. Such a child will probably catch a general impression, as of a white something on a dark background, or *vice versa;* but he does not grasp the characteristics of the words as individual things. His attention is not sufficiently specialized or differentiated for this. He can appreciate only very general or fundamental characteristics in objects of this kind. It is the same with spoken language. The infant long responds to the quality of a voice — the timbre and intonation — before he can even attend to articulated language. The latter demands specialized or differentiated attention, as compared with the former. Again, the principle holds in the reproduction of verbal form. The child of three has perfect control of his hand in the execution of an elaborate repertoire of manual activities, but you cannot

teach him to write words with any success. He cannot particularize his attention as required to perform this special task. So with speech: he can by two years of age probably make separately and spontaneously all the sounds in the language, but he cannot coördinate them into the spoken language used about him, except in respect of the simplest and least complicated combinations.

Now this differentiation in attention as development proceeds is doubtless dependent upon the development of the cerebral cortex. It is known to-day that there is a particular region of the general visual areas differentiated to retain impressions of verbal form. One may become mentally blind for words, but still be able to recognize persons and objects. So the child may learn people and things long before he can learn words, probably because the general visual areas develop before those more specialized; and the principle applies doubtless to the development of all areas. What is elemental and general in function appears before that which is particular or specialized. The implication of this principle is that the infant while being able to construct visual images of persons and objects as we use the term is still unable to construct images of verbal form except in respect to the simplest factors of these forms. He would, then, lack altogether large classes of images within the possession of the adult, which means that his attention, and so his power of self-restraint, must be just to this extent narrow and lim-

ited as compared with the adult.[1] His images without question relate at first almost if not quite wholly to objects and situations with reference to which something must be done at once; appreciation without reaction is for him impossible.

The current conception of the development of the brain as a whole strongly reënforces the view gained from observation of children, — that a young and immature individual must be relatively impulsive and uncontrolled. According to contemporary neurological theory, as expounded by Flechsig,[2] Mercier,[3] Donaldson,[4] and others, the brain is so organized at the outset that all paths lead quite directly to the motor regions. Stimulate a young child in almost any way and you will be likely to get an immediate response. Whatever energy is set free by sensory activity is probably expended in motor reaction. But with development the energy liberated in sensory areas is ever more largely deflected from the original paths and carried through "higher" centers in which are retained the images deposited by experience. Then again,

[1] Cf. with this the theory of Lloyd Morgan (*Psych. Rev.*, March-May, 1905, pp. 79 ff.) that control comes about through differentiation by experience of control centers from automatic and instinctive centers. Then in the process of development comes ideational constructions of logical, ethical, or æsthetic worth that constantly play down upon lower centers, regulating and holding them in check.

[2] See his "Gehirn und Seele."

[3] See his "The Nervous System and the Mind," especially Chaps. V and VI.

[4] "The Growth of the Brain," especially Chap. XVIII.

as the associative functions of the brain mature, any one impression gets connected up with an ever increasing body of experiences which reënforce or check its tendency to issue in action according as the outcome in the past has been agreeable or otherwise. In the beginning the child acts, and thinks afterwards; but with development these processes are turned around. Psychologically this seems simple enough: the infant *must act* in order to gain a knowledge of the values of things, but as he discovers these values he uses his knowledge to guide his future action. Conduct, then, must be precipitous, impulsive, unrestrained at the outset, else the child would never act at all. Control must follow and grow right out of spontaneity. Muscles must dominate in the early years in order that the later ones may be characterized by deliberate, purposeful, controlled action.

The motor character of the child's life is exhibited even in his sleep. Keep watch of a young child during the night, and you will hardly fail to be impressed with the large amount of vocal and digital and bodily activity which you will observe. Curtis reports that above seventy-five per cent of those who made observations for him upon the restlessness of children during sleep detected movements of various sorts. The hands were kept in action, the limbs were made tense, there was a good deal of rolling over, finger twitching, opening and shutting of the mouth, moving of eyelids, sucking the thumb, and so on. These

phenomena indicate how easily the nervous energy of the child finds its way to his muscles, even though the needs of adaptation at the moment do not call for motor activity; and if the parent and teacher and lawmaker do not provide for the expenditure of these energies in legitimate and educative ways, then trouble is bound to ensue, alike for the individual and for society.

Suggestions gained from the phenomena of degeneration.

In what has been said thus far it has been the aim to show that in the early years motor activity is excessive, but as development proceeds the brakes are thrown on, and when maturity is reached mental activity gains ascendency. As mental complexity increases motor excess decreases. It is worth while in this connection to note that in degeneracy there is a falling back over the route by which the individual ascended during his developmental career. The poise and control by which a mature person adjusts himself in happy relations to a complex environment are earliest lost in nervous disintegration.[1] The effect is seen first in lessened restraint of motor action. The tongue is less restrained, for one thing. Then the egoistic impulses manifest themselves more readily in anger, in selfishness, in sensuousness, and in every form. It is well known to alienists that a prominent effect of insanity is seen in the tendency of the patient to react upon situations without due deliberation. Stimuli produce response

[1] Cf., for instance, Bancroft, "Automatic Muscular Movements among the Insane," *Am. Journ. of Psych.*, Vol. III, p. 437.

so quickly that experience counts for little, and instinct comes to the front again. Hall,[1] in his study of anger, points out that irritability, one of the earlier effects of mental disturbance, is caused by the weakening of the inhibitory powers so that the victim becomes the creature of any morbid impulses which may be suggested. Some forms of insanity are characterized by this almost entire lack of inhibitory power, so that primitive, anti-social tendencies run riot in the individual's life.

In the hypnotic state, too, ideas find expression in action almost immediately. In this condition all the inhibitions on original impulses exercised by one's experiences, his teaching, his ideals, are rendered inoperative. Hypnotism thus seems to destroy the inhibitory powers of the cerebral mechanism, and we see the individual in his original estate of motor supremacy. Every one doubtless starts out in life with an equipment of instinctive tendencies, the remains of ancestral life, and these in the process of development usually come under control. In health these, abiding with the individual in the lower regions of the soul, are kept permanently in leash. But when degeneracy sets in, and the higher functions of the brain are impaired, the power of inhibition is reduced, and one becomes the creature of his passions and criminal propensities.[2]

[1] *Am. Journ. of Psych.*, Vol. X, p. 589.

[2] An interesting case cited by Bateman ("Aphasia and the Localization of the Faculty of Speech," p. 189) shows that impressions made upon the nervous organism at one time may be kept from motor realiza-

This phenomenon of descent from control and inhibition to a state where impulses manifest themselves unchecked is seen in inebriety, a form of degeneracy. Wilson[1] tells us that the typical drunkard is irritable, petulant, peevish, and indeed has quite lost control of himself. He is exceedingly disagreeable to live with because he cannot

tion through the inhibitory force of the environment, but in nervous disease, when inhibition is impaired, they may become manifest. "In a Catholic town in Germany," he says, "a young woman of four or five and twenty, who could neither read nor write, was seized with a nervous fever, during which she continued incessantly talking Latin, Greek, and Hebrew, in very pompous tones, and with most distinct enunciation.

"The case had attracted the particular attention of a young physician, and by his statement many eminent physiologists and psychologists visited the town, and cross-examined the case on the spot. Sheets full of her ravings were taken down from her mouth, and were found to consist of sentences, coherent and intelligible each for itself, but with little or no connection with each other. Of the Hebrew a small portion only could be traced to the Bible, the remainder seemed to be in the rabbinical dialect.

"All trick or conspiracy was out of the question; not only had the young woman been a harmless, simple creature, but she was evidently laboring under a nervous fever. Inquiries having been made as to the antecedents of this girl, it was ascertained that she had formerly lived as a servant to an old Protestant pastor, a very learned man, and a great Hebrew scholar. It had been the custom of this worthy divine to walk up and down a passage of his house into which the kitchen door opened, and to read to himself, with a loud voice, out of his favorite books, which consisted of rabbinical writings, together with several of the Greek and Latin fathers; from these works so many passages were identified with those taken down at the young woman's bedside that no doubt could remain concerning the true origin of the impressions made on her nervous system."

[1] See his volume on "Drunkenness."

properly control his egoistic emotions. He has lost the "virtues that make for peace and happiness." His power of attention is lessened; he cannot concentrate his mind fully upon any object; he cannot hold himself persistently to any task — just such characteristics as we find in the child. He is not so good in his judgments; he is rash or timid in his enterprises; he is unable to "direct the balance of probabilities"; his actions are not adapted to the occasions which call them forth; he is, in short, out of alignment with his environment.

It is a matter of common observation, too, that self-control, as we say, is often partially destroyed in fatigue. Here as in other forms of nervous degeneracy the highest and most complex regions are first affected, and they lose their hold upon the lower centers in which abide the primitive impulses and instincts, according to modern theory.[1] Most people when overstrained are "not themselves"; little things annoy them and produce excessive reaction, when in fairer weather they would be able to keep their minds on something more pleasing. Hot words usually come at such a time. When one is in good repair he can restrain himself; he can call to his aid many considerations which will be too powerful for the lower impulses, and so will keep them down.

[1] See the author's "Aspects of Mental Economy," Chap. I, where this subject is worked out in some detail.

TOPICS FOR INVESTIGATION AND DISCUSSION

1. One often hears a parent say of a young child, "He is thoughtless; if I tell him not to do a thing he may do it the next moment, and without intending to disobey me." Have you observed this to be true of children in general? What is the explanation?

2. Discuss the common saying that "A child should be seen and not heard."

3. Compare children who are very active in a motor way with children of the same age who are very quiet; which group is the brighter? Which group stands the higher in the work of the school? Why?

4. Study a school in which the teacher attempts to suppress all motor activity; do you think the children progress unusually rapidly in their studies? Do they seem happy in their work?

5. Can you develop self-control in children by commanding them simply to keep still? Give definite psychological reasons for your answer.

6. Have you ever known a child to develop self-restraint gradually without very much being said to him directly about keeping quiet? If so, just what experiences did he have that brought about self-control?

7. Is it a bad or a good sign for a boy of five or six or seven years of age to be "restless," in the sense that he strives constantly to find motor employment of some sort? Discuss the matter in detail.

8. Many people believe that a school is well governed when pupils sit quietly in their seats, memorizing their lessons. Is this your view? If not, say when a school is well disciplined.

9. Should a pupil exercise greater motor restraint in the high school than he did in the elementary school? Why?

10. If you can possibly do so, read, or better still, *tell* a story full of action to children of different ages, and note whether the response is the same in all cases. If the response is different, explain it by reference to some principle of mental development.

CHAPTER II

DYNAMIC EDUCATION

The passing of the static ideal of education.

THERE is a growing conviction among teachers, and to a certain extent among parents and citizens, that much purposeful muscular action is essential to the proper development of the young. The ancient ideal of a static education, which put the learner of life's ways in a seat and kept him there during his growing years, with folded arms and poring over his book — this ideal seems to be passing in most progressive communities among us. It is true, of course, that the old order is still maintained in some or all of its features in many of the schools of the present[1]; and one must acknowledge, also, that there are

[1] I have had opportunity to observe for a number of years the development of two families where different methods of training the young are followed. The five children in the first family have been continually repressed; they have been taught to sit still, and not to speak until they have been spoken to. They are compelled to be quiet in the house and they are forbidden to play on the street. Their parents never think of indulging in a game with them. They are provided with no materials at home or at school by which they can indulge the constructive instinct. The parents are guided solely by the static ideal of good behavior.

In the other home the training is quite different. Spontaneity is indulged. The father and mother and governess themselves help to carry forward the enterprises of the young ones. Various devices are

still left some eminent defendants of the static régime[1] who see little if any value in motor activities in the school-room. But while there are these conservatives in the educational camp, nevertheless students of human nature, such as James, Hall, Dewey, Mosso, Wundt, Baldwin, and others, are preaching a new gospel. They are saying that the child's thought is never dissociated from his

invented to counteract the unfavorable conditions of the city, so that the children may dig in the sand and climb and build and reproduce in various ways the activities which go on about them.

The effect of these different modes of training is apparent in the conduct of the children. In the first family, the children "behave themselves" better than in the second. They "keep still" and "let things alone." Whenever they are thrown in with other children, though, they appear ill at ease, and often spend their time merely looking at others who are doing things. They seem quite reserved, timid, resourceless. Their faces show lack of originality, independence, freedom. But some of the neighbors say they are "well trained," "well disciplined," because they are not getting into mischief constantly.

The children of the second family, however, are active in any situation in which they may be placed. They conduct themselves as though the world existed to furnish them occasion for activity. They are never at a loss for something to do. The neighbors speak of them, though, as noisy and ungoverned, because they will not sit still and gaze at the world. Their parents find consolation in the belief that as they increase in experience they will have less desire to be testing everything. They expect them to grow more thoughtful and so more restrained. Already, indeed, the eldest child of nine spends of her own accord several hours every day over her story books and drawing and writing and various manual activities.

[1] See, for instance, Münsterberg, *Atlantic Monthly*, May, 1900. See also an article by Briggs, *Atlantic Monthly*, October, 1900. Happily writings of this character are not met with frequently in these times.

muscles; that every idea has a motor aspect; that mind is in one sense a middle term between the senses and the muscles; that it functions for the purpose of guiding conduct; that an idea is not complete until it is realized in action. Then the child must learn the world by dealing with it in a motor way. A seat fastened to the floor is ill-suited to his nature and needs. When he is kept in it a large part of his time his mind grows but slowly and imperfectly, and he suffers injury in his whole being.[1] Instead of learning his letters at five he should be learning the flowers and birds and streams and woods and fields in his environment. He should be learning to use a knife and a saw and a hammer. He should be working in his sand pile, and playing games with his fellows. In short, he should be *doing* under wise guidance [2] rather than memorizing words divorced from action. These are the views which are being passed along the educational line to-day.

We have seen that in the development of the individual the natural order is from motor to mental supremacy,

[1] See Chase, "Neuro-Muscular Development," *Elementary School Teacher*, June, 1904. See also Judd, "Action as a Condition of Mental Growth," *Am. Phys. Ed. Rev.*, 1901, Vol VI, pp. 199 ff.

[2] "Instead of allowing the bodily activities which express themselves in the motor apparatus to shift for themselves, I would have them as carefully trained, and in as systematic a manner, as the so-called faculties of the mind. I would have as great efforts made to help the child systematize his acts as is now made to induce him to systematize his thoughts. I would hold it as important for the child's development that he learn to do as to learn to think. I would not have the school inhibit, but rather direct, the motor activity of children." — BREESE, *op. cit.*, p. 64.

The need of exercising cerebral motor areas

and we should expect that education would best follow this order. The younger the child the greater the need of giving him an opportunity to freely use his hands and feet and voice in educative ways. We are led to this view from whatever standpoint we regard the matter. Donaldson,[1] speaking for the neurologists, maintains that the development of the higher regions of the brain requires that the motor areas should be first exercised in an educational manner, since they are the first to function. If they are permitted to lie fallow, the higher areas which are in some measure dependent upon them can never be completely developed. It is pointed out that imbecility is manifested first in arrest of motor development. The idiot has relatively imperfect control of his muscles. He does not react vigorously upon the world about him, and he rarely develops the ability to perform intricate or sustained motor tasks. In training the feeble-minded Seguin[2] always began with the muscles; and he found that as the defective individual gained in motor power he gained also in mental acumen. But Seguin never had much success in training an imbecile when he proceeded according to the static plan.

Viewed now from the psychological standpoint it appears that muscular experiences are essential to the gaining of clear, definite, effective ideas of the world. Action,

[1] See his "The Growth of the Brain," Chap. XVIII, especially p. 355.

[2] See his "Idiocy and its Treatment by the Physiological Method."

What is implied in *understanding* a thing?

as Judd says,[1] is a condition of mental growth. To know a thing means in part that one understands what can be done with it in a muscular way.[2] Thus I do not know a horse in any complete manner until I have tried to manage him — measured my muscles against his, and had vital relations with him. Simply looking at him can not give me effective knowledge regarding him. I see a group of children tussling every day with several dogs, and the knowledge they are gaining in this way is valuable because it informs them respecting the characteris-

[1] See the *Am. Phys. Ed. Rev.*, 1901, Vol. VI, pp. 199–203.

[2] "When in the presence of familiar objects, such as our pen, our watch, our knife, our dictionary, or our bunch of keys, if we examine the images that these objects awaken in us as we observe them, we may often find images of a more or less obviously motor type — images which take the form of tendencies to conceive to ourselves certain familiar acts which these objects call up in our minds. Thus the pen may arouse the image of grasping the pen for the purpose of writing, the knife may suggest cutting, and so on. In brief, the whole normal life of our imagination has a most intimate connection with our conduct, and should not be studied apart from conduct. The central processes which our images accompany form themselves a part of our reaction to our environment, and our more organized series of mental images actually form part of our conduct. This aspect of the matter is one which many psychological studies of our mental imagery lead us altogether too much to neglect. And many teachers suppose that to train the imagination of children involves something quite different from training their motor processes. But the normal imagination of healthy children is likely to get a rich expression in the form of their plays, of their dramatic impersonations, of their story-telling, and of their questions about things. And the most wholesome training of the imagination is properly to be carried out in connection with the training of conduct." — ROYCE, "Outlines of Psychology," p. 159.

tics of these objects, and their own power and capacity in relation to them. Suppose a child had only eye-knowledge of a dog ; what would it be worth to him? Muscular knowledge was fundamental in the race, and it is the basis of all true learning in the individual. Eye- and ear-knowledge has been grafted upon this fundamental thing in the evolution of the race, and it must be grafted upon it in the development of the child.

Again, effective learning not only of objects as such, but of activities as well, requires the use of the muscles. Sense impressions are extremely hazy and indefinite, to say the best, until they have been defined by vital contact with the objects yielding them.[1] A child cannot gain a true conception of a blacksmith as a particular sort of individual until he has more or less fully reproduced his peculiar activities.[2] To comprehend what a blacksmith is in his peculiar function requires that one imitate him in his special work. Mere reading about him or gazing at him from afar off gives no adequate knowledge of him. Knowing an object requires kinæsthetic as well as auditory or visual data concerning it. Indeed, to be precise, knowledge in the true sense comes from the *back stroke*, as

[1] Cf. Breese, *op. cit.*, p. 60.

[2] "Here we find an explanation of the fact that the boy who gains the ability to perform bodily adjustments in a decided, accurate, and rapid manner is better able to think accurately and clearly, and why a hesitating and ineffective bodily reaction is the accompaniment of a weakened or confused state of mind." — Breese, *op. cit.*, p. 65.

Bolton says. Motor activity furnishes consciousness with most important elements for psychical development, so that "mental development and motor power go hand in hand."[1] One knows what a thing is after he has reacted upon it, not before. The mission of eye and ear is to give us second-hand or inferential knowledge, to reinstate former experience; they cannot give us original, first-hand knowledge of many of the vital situations of life.

It should be recognized, though, that if the child has had experiences like those of the blacksmith, he will, when he looks at him now, have these revived more or less fully. It happens, then, that in the process of development there is less and less need of the actual repetition of certain activities observed, except when the immediate needs of adjustment demand it. We see the child of two, say, incessantly imitating simple activities that go on about him until he can perform them readily, when he gradually abandons them and takes up something new. The original activities are not forgotten, but they do not have to be executed in full in order that the individual may comprehend them. The sense factor reinstates enough motor and organic accompaniments to give a feeling of familiarity or understanding.

It seems as though the child is so constituted that when

[1] Bolton, "The Relation of Motor Power to Intelligence," *Am. Journ of Psych.*, Vol. XIV, p. 353.

he beholds an action at all closely related to the circle of activities in which he is interested at the time he must execute it in his own conduct. The action seems to urge itself out into his own motor processes. If it is quite new it encounters resistance and so the child must give himself fully to it. When it has been wrought out, however, it gradually gets repeated more and more easily by the imitator, until it can be reproduced as a sort of echo. But it would manifestly be a disadvantage if, at every period of life, one was compelled to execute in detail any activity in order to comprehend it; he would either have to become a sort of human kaleidoscope, or else he would not respond at all to most of the copies in his environment. This difficulty has been overcome by a kind of short circuiting of the reaction complex, whereby the sense element comes to reinstate the *back stroke* without the motor processes which originated it. If you will trace the natural history of any of the child's imitations, you will see the motor elements of familiar ones constantly subsiding, and the motor processes of new imitations taking their places. The central elements of the imitations that have been mastered remain in a generalized form and this is all that is needed for adjustment. So the individual grows on, until in maturity, if he has had broad experience, he bears in his organism the distinguishing elements of numberless imitations, the motor phases of which have seemingly wholly disappeared. These essential elements enable

him, however, to interpret the world of action about him, and this is apparently one thing which imitation is designed to accomplish.

Motor activity in the traditional schoolroom.

The point I am urging is that significant motor activity is required for effective learning. But the furnishings of many of our schoolrooms indicate that pupils are expected to devote themselves entirely to the memorizing of words.[1] It is not regarded by some as necessary that the learner should live over in a concrete, dynamic way the experiences of those who developed the words as symbols of their experiences. Mere word learning was so prominent in the days of Rousseau and Locke that their educational writings were devoted mainly to awakening the people to the need of reform in this respect. "In any study," says Rousseau, "words that represent things are nothing without the ideas of the things they represent. We, however, limit children to these signs, without ever being able to make them understand the things represented. We think we are teaching the child the description of the earth, when he is merely learning maps. We teach him the names of cities, countries, rivers; he has no idea that they exist anywhere but on the map we use in pointing them out to him." Locke expresses his views to the same effect, and goes even further; and it might be truthful

[1] See Rice, "The Public School System of the United States," for many illustrations of mere verbal teaching in the schools in different cities in our country. The whole book may be read, but see especially pp. 34–37, 42, and 55.

to say that every great educational writer for the past two centuries at least has endeavored to show up the shortcomings of verbal teaching.[1]

[1] Illustrations of the results of verbalism may be found in abundance by any one who will visit a school where the memorizing of words is the chief occupation. In one school a class was recently heard reading "The Old Oaken Bucket." They rattled off glibly the words: —

"How dear to this heart are the scenes of my childhood
When fond recollection presents them to view;
The orchard, the meadow, the deep-tangled wildwood,
And every loved spot which my infancy knew;
The wide-spreading pond, and the mill that stood by it;
The bridge and the rock where the cataract fell;
The cot of my father, the dairy house nigh it,
And e'en the rude bucket which hung in the well!
The old oaken bucket, the iron-bound bucket,
The moss-covered bucket which hung in the well."

When they had finished, the teacher was asked if they appreciated the poem, and she appeared surprised at the question. "Didn't you hear them read it? Didn't they pronounce the words correctly?" she queried. To test their understanding they were asked to go to the board and illustrate the poem. One child drew a large circle and put in it four loops, and filled in the rest of the space with dots, when she appeared perfectly satisfied with her illustration. Asked to interpret it she pointed to the first loop and said, "e'en the rude bucket which hung in the well." Pointing to the second loop, "the old oaken bucket which hung in the well"; the third, "the moss-covered bucket which hung in the well." When asked what the dots meant, she said, "Oh, those are the loved spots which my infancy knew." Much of the teaching of the "tools" when divorced from real, vital knowledge of men and things is of no more value than "The Old Oaken Bucket" was to this class.

A few years ago Caroline Le Row examined a number of children who had been taught in this manner, and she obtained some results that are suggestive. Here are some specimens of the wisdom gained from the

Reform has begun in the kindergarten.

But there are signs of better times ahead. The kindergarten among us is providing, to some extent at least, opportunities for dynamic education. In the leading kindergartens to-day the pupil devotes much of his time to constructive activities that are carefully planned to meet his special needs. Again, he reproduces in his plays in the circle the simpler occupations of the people with whom he comes in contact in his daily life. The true kindergarten is a place of *action*, of *doing*, of testing, of experimenting,[1] of practicing in play the serious enter-

teaching of ciphering; and similar results were obtained in other subjects: —

"Subtraction is the minuend and the subtracted end.

"When there are two equal numbers it is called multiplication.

"A quotient is a prime factor and is always a number, or some part of a number.

"A composite number is just the same as a prime factor.

"Brokerage is the allowance for the breakerage and leakerage of bottles.

"Insurance is when you die, or burn your money, and the insurance office pays you for it.

"Exchange in Europe is when you go through London, Paris, and places.

"When you exchange money all you have to do is to get the right change.

"If there are no units in a number, you have to fill it all up with zeros.

"Units of any order are expressed by writing in the place of the order.

"If fractions have a common denominator, find the difference in the denominator.

"Interest on interest is confound interest.

"The rule for proportion is to multiply it by all the terms."

[1] "In the kindergarten, knowledge is made clear by the self-activity of the child. All growth of human power is based on the self-activity of

prises of later life. The pupil does not spend his time memorizing the word for knife, to illustrate, but he *works* with it, and so really learns it because he discovers what he can do with it, which involves knowledge of its mechanical properties, how it must be handled, and so on. He does not view from afar off, as the pupil in the elementary school sometimes does, the sphere and cube and cylinder and recite about their "properties,"[1] but he uses them in his games, and in constructing houses and other objects in which he is interested.

The kindergarten is not yet wholly free, though.

I do not mean to say that there is no formalism left in the kindergarten; that the static regimen has been abandoned altogether. Unhappily there is still some parrotlike reciting of phrases concerning divine love, patriotism, duty, and the like that have no influence upon the conduct of the pupils, for they cannot comprehend them because they are not yet making adjustments where these things are involved. The kindergarten offends seriously against the nature of the child in enforcing *verbal* patriotism and piety and love upon him. Patriotism and similar virtues must be left until the pupil begins to play his part in shap-

the individual to be developed. No thought is ever definite until it has been consciously lived out or wrought out. The kindergarten makes use of self-expression in the child to define the thought already in its mind, and to reveal new thought. There is no other way by which thought can be clearly revealed and defined." — HUGHES, *Pop. Sci. Mo.*, Vol. 45, pp. 210–211.

[1] See Rice, *op. cit.*, pp. 35–36, for examples of the static method.

ing the destinies of his country. When he comes to assume the duties of a citizen in some simple activities at least, then is the psychological moment to talk to him about patriotism. Then teaching will not be mere idle singing, for what is taught can be realized in action.

The teaching of verbal patriotism as a typical abstract conception.

This will be the best place, perhaps, to say a word regarding the teaching of patriotism, as a typical matter of school concern, elsewhere than in the kindergarten. One will not be accused of dogmatism when he says that respect and love for our country, and devotion to its laws and institutions, can never be developed in the young in an effective way by a mere formal study of the machinery of government. Mechanical conning of definitions in civics and political economy will never fill the hearts of youth with genuine enthusiasm for their native land. Some of us know how cold and indifferent our text-book study of civics in the elementary and secondary schools left us. Carlyle's apotheosis of Action, Work, seems especially appropriate in its bearing upon knowledge relating to the duties of free citizenship. "The knowledge that will hold good in working," he says,[1] "cleave thou to that; for Nature herself accredits that, says Yea to that. Properly thou hast no other knowledge but what thou hast got by working: the rest is all a hypothesis of knowledge; a thing to be argued in schools, a thing floating in the clouds, in endless logic vortices, till we try and fix it."

[1] "Essay on Labor" (New York, 1867), p. 185.

Education for citizenship must at every point be *dynamic.* The child must at the appropriate time be made to *participate* in a concrete, vital manner in the functions of government in the circumstances of his daily life. In this way he should be led to appreciate the reasons why he must do the things which the regulations of his community constantly enforce upon him and his fellows. He must be made to realize, not in definitions and verbalisms, but in persons and actions, the source of authority for these regulations, and by what right certain individuals are clothed with power to compel their observance. This direct face-to-face and hand-to-hand contact with law, both in its operation and in its making, will alone win from our youth respect for and confidence in our institutions,[1] and develop in them patriotic and law-abiding conduct.

TOPICS FOR INVESTIGATION AND DISCUSSION

1. What changes in teaching have taken place within your own memory? If possible observe the work to-day in the school which you attended in childhood. Write out as fully as possible the changes you can detect: (*a*) in the teaching of the

[1] Emperor William is putting the principle into operation, although in an imperfect way, perhaps, when he arranges for the schoolboys of Germany to spend a few days on his warship and see and hear and feel what is there presented, instead of simply learning words about it all in some class room, practically as remote as the ends of the earth from the real heart and life of things.

various studies, — arithmetic, geography, etc.; and (*b*) note whether discipline is more or less rigid than it was formerly.

2. Do you thoroughly comprehend any object which you have never handled, or experimented with in any way? If so, show how you acquired your understanding. Do you think you really understand any game or art which you have never tried? Give psychological reasons for your answer.

3. It is said that men reared in the country suffer less from nervous overstrain in modern city life than men reared in the city. What observations have you made in respect to this matter? Would you expect the statement to be true? Why?

4. Could you learn to understand a foreign language when spoken if you never spoke it yourself? Have you known people who could read "silently" after they had lost speech?

5. Why does a child use his lips in reading? Would you prevent him from doing this in the beginning?

6. What do you consider to be the chief defect in the methods of the school in which you were trained?

7. Is there any injury likely to result to a pupil who learns words without having any comprehension of what they denote?

8. In what respects is the kindergarten better suited than the ordinary primary school to the nature and needs of childhood? In what respects is the primary school superior to the kindergarten?

9. Study the schoolrooms in your vicinity; in what respects are they ill-adapted to the nature and needs of childhood? Are the most serious defects in the primary grades or in the high school?

10. What are the arguments for and against permitting children to communicate with one another during school sessions?

CHAPTER III

THE DYNAMIC ASPECT OF SCHOOL STUDIES

Arithmetic as an instance.

WHAT has been said in the foregoing chapters respecting the place of motor activities in mental development applies in principle to the teaching of all studies. The pupil in the elementary school can gain genuine mastery of number, for example, only by *using* it in a concrete manner, in the construction of his playhouses or other objects, in buying and selling, in weighing and measuring, and in all the ways necessitated in the carrying forward of the enterprises of daily life. There is so much the child wants to do that to do well requires the ready and accurate use of arithmetic that we need experience no difficulty in presenting it to him in a dynamic manner. What the pupil is unable to *use* at any time cannot be taught him most economically and efficiently at that time.

The Committee of Ten, among other committees as well as individuals,[1] has recently protested wisely, I think, against much that is taught under the term " commercial

[1] See, for instance, Dewey, "The Primary School Fetish," *Forum*, Vol. 25, pp. 285 ff.; Bolton, " Facts and Fiction in Educational Values," *School Review*, February, 1904; McMurry, " What Omissions are Advisable," etc., Add. and Proc. N. E. A., 1904, pp. 194 ff.

arithmetic." In speaking of such subjects as banking, insurance, discount, partial payments, equation of payments, and the like, the Committee says that in the text-books we find the subjects in question prefaced by very excellent definitions. "The pupil who masters them will be able to state on examination that the market value of stock is, what the stock brings per share when sold for cash; that stock is at a discount when its market value is less than its par value; that its par value is that named in the certificate; that the payee of a bill of exchange is the person to whom the money is ordered to be paid; in fine, to state in brief sentences the first principles of commercial law. He may also, after much conjecturing, be able to solve many questions in banking, exchange, insurance, and custom-house business. But until he is brought into actual contact with the business itself, he can form no clear conception of what it all means, or what are the uses or applications of the problems he is solving. On the other hand, when he is once brought face to face with business as an actuality; when for the first time he becomes a depositor in a savings bank, or a purchaser of shares in a corporation, he will find all the arithmetic necessary for his purposes to be interest, discount, and percentage. The conceptions which he vainly endeavored to master by recitations from a text-book take their places in his mind with hardly the necessity of an effort on his part."

It is encouraging to note the change which is taking

place in the text-books in arithmetic. Those now coming from the press are requiring the pupil to *react* upon his environment, employing number as an aid. The method of sitting still and memorizing definitions, or mechanically learning fundamental operations and applying them to the solutions of problems entirely remote from the pupil's daily life — this method is losing its hold, though it has not disappeared altogether by any means.[1]

The dynamic principle applies to all studies.

The principle here in question is universal in its application. The pupil will gain his reading and writing and spelling most effectively by using them in a vital way. They must not be set apart from his active life, but must be made the means of his gaining useful knowledge and recording it, and communicating with his friends. I see children as early as the sixth year strive with all their might to write well when they wish to send a letter to some friend. Then they will give attention to chirography and spelling. I see them digging out words, and seeking help from every source, when they wish to get at the story in some interesting book. University students must be driven to study German or French when they have, so far as they can see, no use for the language; but when a professor needs it to carry on his researches, or his studies in foreign countries, then observe how vigorously he attacks it, and what progress he makes.

Some of the reading books coming from the press are

[1] See Rice, *op. cit.*, p. 42.

Reading in an older day.

reflecting the new ideal. What a contrast between the first book with which many children among us begin their reading, and the old New England Primer! In our times the child may make his own lessons, telling of the things that are of interest to him; or he may get them in the form of stories that he loves dearly. And the aim is to make everything real and vital and attractive by illustrations that represent familiar situations in the pupil's active life. But note the contents of the first reading book of our forefathers, published in 1777, and see how remote they are from the real interests of the young: "The child's morning and evening prayer; the alphabet, vowels, consonants, capitals, small letters, syllabarium, consisting of ab, eb, ib, etc., and lists of words for spelling arranged according to the number of syllables, beginning with monosyllables, and ending with abomination, exhortation, etc.; a lesson for children, including such unadorned moral injunctions as: Pray to God, Tell no lies, Call no ill names, Mind your book, Be not a dunce, etc.; a series of woodcuts associated with the letters of the alphabet in order, beginning with the tree of forbidden fruit, the serpent and our first parents, and all arranged in appropriate rhyme. Thus: —

"'In Adam's fall
We sinned all.'"[1]

[1] Reeder, "The Historical Development of School Readers and Method in Teaching Reading," p. 15.

"The edition published in 1831 contains several poems, a moral catechism, including abstract treatises on humility, mercy, anger, justice, gratitude, avarice, frugality, industry, etc.; precepts concerning social relations, in which the young man, young woman, husband, wife, parent, and child are all briefly instructed and admonished concerning their duties and responsibilities." [1]

The principle under discussion applies to the teaching of language and drawing and geography and science, as well as to arithmetic and reading and writing and spelling, and I need not delay longer in discussing its application to these studies. A word should be added, however, respecting its bearing upon the work of the secondary school. Many well-informed teachers of our day maintain that formalism has endured longer in the high school than anywhere else. Secondary teachers as a whole seem to have had a kind of morbid fear of studying the professional side of their work, although there are evidences of some improvement in this respect. And as soon as a teacher begins seriously to study the purposes and method of teaching he is likely to lose faith in the virtues of a formal, static régime. The Committee of Ten has aroused the high school, in many places at least, to a sense of its great shortcomings in the matter of making its teaching real and dynamic. Heretofore the chief emphasis in the teaching of ancient language was put upon the memorizing of

The high school as the last in the procession.

[1] Reeder, *op. cit.*, p. 32.

rules and forms, and syntactical constructions. Syntax was made an end it itself, and not "an auxiliary to the penetration of the sense." But we are told by the Committee of Ten,[1] that "at the very outset the student should be made to understand that these things are not ends but tools, and that the end is to gain, through the reading of Latin, an insight into the thought and feeling of a people who have contributed very largely to make the life of the civilized world of to-day what it is. The 'Commentaries of Cæsar,' the 'Epics of Virgil,' and the 'Orations of Cicero' — commonly spoken of as subjects required for admission to college — are in reality masterpieces of literary style and historical documents of first-rate importance. The teacher, from whose attitude of mind his pupils are likely to take their own attitude, will do well not to allow the burden of daily work and yearly repetition to lead him to set up a mechanical conception of Latin as a field for intellectual gymnastics, in place of the true conception of a vital literature, capable of exerting a strong attraction upon the young student (for the most part possessed as yet of but a very slight vision of any world except that which is immediately about him), and of becoming a powerful influence for the training of his taste and the awakening of his intellectual ambitions."

The pupil, that is to say, is to gain Latin or any other

[1] *Op. cit.*, p. 73.

language[1] by *using it* in the attainment of ends of value to him. What a different view this is from that taken by Mr. Stelling in the teaching of Latin to Tom Tulliver! Tom had no idea what it was all about, and his tutor, having faith in the value of pure drudgery, was not moved to enlighten him on the subject, and as a consequence things went badly for both teacher and pupil. The static ideal has until quite recently held complete sway in the teaching of the mother tongue. The notion that facility and effectiveness in expression could be and ought to be acquired only when the pupil reached the point where these things would be of service to him in his real life — this notion is but just appearing among us; and the worship of formal grammar and rhetoric and philology begins to show signs of decline. These are of value to the high school student only as they aid him directly in revealing himself effectively (which includes clearness, accuracy, grace, etc., in his expression) to his fellows. He should never be required to learn rules and forms as ends in themselves,[2] or in the belief that at some distant

Can language be taught in a dynamic way?

[1] Every teacher of foreign language should read Gouin's delightful and instructive essay, giving the results of his experience in learning the German language, — Part First of his "The Art of Teaching and Studying Languages" (London, 1902).

[2] What the Committee of Twelve of the Modern Language Association of America (Report of the United States Commissioner of Education, 1897–1898, p. 1414) says regarding the value of grammar in the study of a foreign language applies with even greater force to the study of the mother tongue. "In the teaching of grammar," the Committee says, "the

time he may chance to need them. He must get them *when he needs them*, neither before nor after. In this way they will be brought into his active life; they will become organized into power because they will help the individual to deal the more successfully with certain situations in which he is placed. Talking and writing and gesticulating [1] for mere drill contribute little if anything

most important principle to be kept in view is that the grammar is there for the sake of the language, and not the language for the sake of the grammar. The recitation of paradigms, rules, and exceptions is always in danger of degenerating into a facile routine in which there is but little profit. The important thing is not that the learner should acquire facility in telling off paradigms, quoting statements, and explaining principles according to the book, but that he should acquire facility in understanding and using the language. The maxim should be, Little theory and much application. It is of small use to be able to state correctly the principle of adjective declension, so long as the pupil, in attempting to apply the principle in a simple case, is obliged to stop and think, to recall his grammar, and perhaps to guess after all. The right forms must be so bred in to the blood that they come naturally from tongue and pen."

[1] Formalism is still rampant in the teaching of elocution and oratory. Definitions and mechanical gesturing are supposed to develop capacity for ready and effective expression. Caroline Le Row gives some results of an examination in oratory that are diverting and perhaps suggestive. Here are a few illustrations: —

Elocution is opening the mouth wide open.

It is a very important thing to breathe.

We should always breathe with the musels of the diagram, unless we have catarr or a cold in the head.

Strong breathing prevents bilious deficiencies.

Good breathing prevents contagious diseases from settling in the system.

to efficiency in expression. The Committee of Ten, speaking on this point, says it "doubts the wisdom of requiring for admission to college set essays — essays whose chief purpose is to test the pupil's ability to write English. It believes that there are serious theoretical and practical objections to estimating a student's power to write a language on the basis of a theme composed not for the sake of expounding something that he knows or thinks, but merely for the sake of *showing his ability to write.*"

It is gratifying to see that the static method is beginning to lose caste among the best teachers of modern languages. The Committee of Twelve, as well as the Committee of Ten, has emphasized the need of making a foreign language *significant* to the pupil; of so handling it that he will feel its usefulness in his daily life. It must not be regarded as a thing apart from his vital interests. Says the Committee of Twelve,[1] "The study of French and German in the secondary schools is profitable in three ways: First, as an introduction to the life and literature

Breathing is very good for reading for when you are reading you carnt breathe at all and so it is good to breathe a good deal before.

Vowel sounds are made by keeping the mouth wide open and consonant sounds,by keeping it shut.

The asperate quality of voice is when you try to say something in a whisper.

Force is more loudness sometimes than others.

Emphasis is putting more distress on one word than another.

Inflection is when the voice goes up and then down again it is a period.

[1] *Op. cit.*, p. 1393.

of France and Germany; secondly, as a preparation for intellectual pursuits that require the ability to read French and German for information; thirdly, as the foundation of an accomplishment that may become useful in business and travel." This has the right ring to it, for it makes language study minister to a need arising in the pupil's broadening life. If this conception be carried into effect, the pupil will in the mastery of French or German become possessed of a tool which he can use to very good advantage in the situations in which he is likely often to be placed in the world outside the schoolroom.

The teaching of science in the high school.

What has been said of language applies equally well in principle to all the studies of the secondary school. But a word on the teaching of science may be added before this subject is dismissed. Some of us can remember when physics, chemistry, botany, zoölogy, physiology, and astronomy were taught almost wholly from a text-book, and in the space of thirteen weeks each. A few years ago it was deemed a waste of energy for a pupil to spend time over a microscope or a piece of physical apparatus. Sometimes the instructor would illustrate an experiment, but usually he had neither the skill nor the equipment to perform experiments successfully. Rice[1] tells of observing a class in physics in one of our great cities; and there being nothing but the text-book in evidence he asked the teacher if she allowed her pupils to experiment by themselves.

[1] *Op. cit.*, p. 60.

"'Oh, we have no experiments,' she said. 'We learn our physics from books. The city supplies us with no apparatus. We are at liberty to experiment if we desire.' A friend of mine, a principal, informed me that she tried to make an experiment once, but it was a failure, and she vowed she would never dream of making another one.

"In one class where they were having physiology, in answer to the question, What is the effect of alcohol on the system? I heard a ten-year-old cry at the top of his voice, and at the rate of a hundred miles an hour: 'It — dwarfs the — body — and — soul, — weakens — the — heart — and — enfeebles — the — memory.'

"'And what are the effects of tobacco?' asked the teacher.

"In answer to this, one boy called off, in rapid succession, more diseases than are known to most physicians." [1]

[1] I cannot forbear giving a few more choice specimens from Caroline Le Row's collection. And first, physiology: —

Physillogigy is to study about your bones stummick and vertebry.

We have an upper and lower skin. The lower skin moves all the time and the upper skin moves when we do.

The body is mostly composed of water and about one half is avaricious tissue.

The chyle flows up the middle of the backbone and reaches the heart where it meets the oxygen and is purified.

In the stomach starch is changed to cane-sugar and cane-sugar to sugar-cane.

Here are some brilliancies in astronomy: —

The weight of the earth is found by comparing a mass of known lead with that of a mass of unknown lead.

The static method is as bare and ineffective in science as in any other study. The pupil's relations to the world described by the sciences are very concrete and dynamic, and the work of the schoolroom should perfect him in these relations. Happily reform is already setting in. The past five years have witnessed great changes for the better in science text-books, and many voices are now raised against confining the study of nature to the printed page, all agreeing that the pupil must go out into nature and there hold communion with her visible and invisible forms. He must learn what nature is by trying what he can do with it; thus he measures it in terms of his own strength and skill, and discovers how it can be manipulated; and it is this experience that yields vital knowledge, and that enlists genuine interest.

TOPICS FOR INVESTIGATION AND DISCUSSION

1. Show how mensuration in arithmetic may be taught in a dynamic way. Also the tables of money, weights, liquid and dry measure.

2. How much of commercial arithmetic will the majority of pupils use in their daily lives? How much do you use in

The size of the earth is found by finding the horizontal parallax of the sun.

Abberation is if we saw a star and shot at it the shot would not pass through the center but through the side.

Eclipses are caused whenever the obscuration of a body is passed by the shadow of some other body.

The stars would cover up the whole heavens if they were all spread out so astronomers have concluded to arrange them in constellations.

your own life? Can you teach commercial arithmetic to children in the elementary schools so that they will *use it as they acquire it?* Or if taught must it be acquired by definition and by solving book problems?

3. Comment on the value of arithmetic to a pupil who has never had opportunity to employ it in practical situations — whose experience with it has never extended beyond the text-book.

4. Point out the difference in methods in teaching writing in a dynamic and in a static way.

5. Show how you would teach reading dynamically to pupils in the third grade, say. Have you observed that reading is ordinarily taught in this manner?

6. Indicate how you would teach the mother tongue dynamically. Can grammar be so taught? Show how.

7. How may German, as a typical foreign language, be taught dynamically? Compare two pupils who have been taught German for the same length of time, one in a static, verbal way, the other in a dynamic way. How will they differ in their mastery of the language?

8. What is the static, verbal method as applied to music? to drawing? Outline a dynamic method for presenting these studies.

9. Show how the dynamic method may be applied in the teaching of (*a*) history, (*b*) literature, (*c*) physics.

10. Compare the high schools and the elementary schools in your locality. Which, so far as you can observe, are the more vital and dynamic in their teaching? What are the evidences upon which your opinion is based?

CHAPTER IV

MANUAL ACTIVITIES IN EDUCATION

Some current views of manual activities

It has been the aim thus far to show that the school should teach the common studies in a dynamic way; but we must turn now to a group of subjects — domestic science, wood and iron working, mechanical drawing, etc. — that are generally thought to require muscular activity principally in their prosecution. These studies have gained admission to the curriculum mainly because some people have felt that the young need muscular activity and training, and the school ought to provide for it. The ordinary studies offer no opportunity for it; they discipline the memory in the main. So there must be work with tools, — hammering and sawing and cooking and sewing. It has been appreciated by a few, of course, that manual activities do more for the individual than simply exercise his muscles; they make perception keener, and thinking more accurate.[1] They exert a beneficial

[1] See the following important articles treating of the theory of manual activities and their employment in education: Shaw, "The Employment of the Motor Activities in Teaching," *Pop. Sci. Mo.*, Vol. 50, pp. 56–67; Patrick, "Should Children under Ten Years Learn to Read and Write," *Pop Sci. Mo.*, Vol. 54, pp. 382–392; Dewey, "The Primary School Fetish," *Forum*, Vol. 25, pp. 315 *et seq.*

influence upon one's character, too, since they develop a comprehension of and respect for law. A pupil, so the argument runs, who day after day sees that in the material world failure to hew to the line results disastrously will come gradually to realize the necessity of hewing to the moral line in all his conduct. Further, these manual activities are adapted to awaken and develop æsthetic appreciation, since the making of beautiful forms is the essential requisite for æsthetic perception.

The originators of manual training as it is understood among us [1] apparently saw that the practical value, in the material sense, of joining, turning, basket making, and the like was of minor importance when compared with the intellectual, æsthetic, and moral values. And most present-day students of the matter seem to have reached this general conclusion. Adler [2] has pointed out that the occupation of the workshop and the atelier contributes to give the pupil the power of judging impersonally, which is essential for the right estimate of moral situations. The effort to give definite, mathematical, and æsthetic form to formless material, requiring continuous attention and toil, develops the habit of looking at things from the standpoint of their intrinsic rather than their superficial qualities; and the experience thus gained with material

[1] Cygneus, in Finland, 1858, and Della Vos, St. Petersburg, 1868.

[2] Quoted by Woodward, "The Rise and Progress of Manual Training," Report of the Commissioner of Education, 1893–1894, Vol. 1, p. 889. See also Abel, "An Experiment in Education."

things insensibly affects all one's relationships. "A delicate sensibility to true and harmonious relations will be engendered, and the impressions thus obtained can later on be raised into convictions by direct moral instruction. The pupil, when of sufficient age, can be taught that in the world of thought and feeling, too, truth and harmony of relation are to be the sole ends to be sought. He can be exhorted to undergo similar toil, to be prepared for similar failures and disappointments, in order to realize at last something of the same inward perfection which is to be his only and all-sufficient reward. Thus while he is shaping the typical objects which the instructor proposes to him as a task, while he pores silently, persistently, and lovingly over these objects, reaching success by dint of gradual approximation, he is at the same time shaping his own character, and a tendency of mind is created from which will eventually result the loftiest and purest morality."[1]

The real value of manual activities.

The defendants of manual training generally maintain, as Professor James does,[2] that its value lies primarily in the benefit which an individual derives from dealing in an exact way with material objects. In this manner he gains a sense of the reality of things, and of the necessity

[1] I attempt in the following chapter to point out some limitations to the value of manual training. The claims of Mr. Adler and others may, from one standpoint, be regarded as excessive.

[2] *Atlantic Monthly*, March, 1899. See also his "Talks to Teachers," etc., Chaps. V–VII.

of coördinating his actions in conformity with the nature of these things. In this work right and wrong are readily detected, and the reward for right action and punishment for wrong action is direct and positive. There is no escape. In the more complex affairs of life, however, right and wrong are not so readily discerned, and the outcome in any case is not so apparent; and the pupil can best be got ready to discern these subtler relations by giving him much experience in observing them in the more simple situations.

The prevailing view to-day may best be presented in the words of Professor James. "The most colossal improvement which recent years have seen in secondary education," he says, "lies in the introduction of the manual training schools; not because they will give us a people more handy and practical for domestic life and better skilled in trades, but because they will give us citizens with an entirely different intellectual fiber. Laboratory work and shop work engender a habit of observation, a knowledge of the difference between accuracy and vagueness, and an insight into nature's complexity and into the inadequacy of all abstract verbal accounts of real phenomena which, once wrought into the mind, remain there as lifelong possessions. They confer precision; because if you are doing a thing, you must do it definitely right or definitely wrong. They give honesty; for when you express yourself by making things, and not

by using words, it becomes impossible to dissimulate your vagueness or ignorance by ambiguity. They beget a habit of self-reliance; they keep the interest and attention always cheerfully engaged, and reduce the teacher's disciplinary functions to a minimum." [1]

[1] Compare this statement of Professor James with those made by some of the "leading educators" when manual training was getting itself born in this country. President Gray said in the *School Journal*, June 23, 1888: "The apotheosis is complete. But one thing further is to be said, and that is potentially said, in the statement given above, viz.: Morse or Fulton is a grander figure in the progress of man than is Plato or Jesus Christ. The latter made neither steamboats nor telegraphs. He wrought in the world of thought, as did Plato, but the man who invents a sewing machine is greater than both. For shame, intelligent, Christian, American teachers!"

Dr. E. E. White, in discussing manual training at the meeting of the N. E. A. in Saratoga, 1888, maintained that "this doctrine saps the very foundation of the public-school system, puts a magazine under it, and then lays a train out to fire it. The educator who does that cannot blame the outsider if he fires that train, and the public-school system, in some of its important departments, is blown up before his eyes. He need not be startled at such a result, for he put the magazine under it."

Superintendent Marble, on the same occasion, presented somewhat similar views. "The schools we are to conduct," he reasoned, "are to train boys and girls in those directions that are common to everybody, and one of the things that the boys and girls ought to learn in those schools is how to get information from books. There is no information stored up in the plow, hoe handle, steam engine; but there is information stored up in books. If a boy is prepared to get information from books, he can make indefinite progress. If you take out of his hand the books and put in there the handsaw and the hammer, and ask the teacher — who is most likely a young girl — to teach them, when she does not know anything about them, the whole matter will simply become 'a bore' to all parties concerned. The saw is brought into the recitation room, and the

The child's first absorbing interest.

In the earliest years the pupil's chief interest is in *constructive activity*. If he be given freedom to do as he chooses, and suitable equipment, by far the larger part of his time will be spent in construction, in imitation of the activities going on about him. If he has blocks he will be building; if paper and scissors he will be cutting; if sand he will be modeling; if tools he will be framing a box or a house or what not; all, of course, in a crude, imperfect way. These activities, as Professor Dewey says,[1] "evoke and direct what is most fundamental and vital in the child, that in which he is the heir of all the ages, and through which he recapitulates the progress of the race. It was certainly a gain for educational theory and practice when

teacher says, 'Now, saw.' It is a thing that does not belong to the school at all. It belongs outside, and ought to be attended to outside."

Now contrast with these views the opinions of a present-day experimental psychologist. "Manual training develops the intellectual side of the mind as nothing else can. By book work or by study a boy never learns to think or understand, or even remember, as well as he might; it is only when he gets involved in sports and games like baseball and canoeing, or in machinery like lathes and buzz saws, or in laboratory complications like chemical analyses and measurements of electricity, that he ever learns to think fully as a man. . . . Honesty is directly developed by all exercises in precise measurement in a regular gradation from the blacksmith's forge upward through the carpenter's bench, the machinist's lathe, the chemist's balance, and the physicist's electrical scale. Careful courage is directly developed by the grasp on a sharp instrument, or by facing a rapidly whirling lathe. Sociability and solidarity are developed by the games of the kindergarten and by the making of pieces of machinery in common." — SCRIPTURE, *Manual Training Magazine*, Vol. I, No. 1, p. 24.

[1] In the *Manual Training Magazine*, July, 1901, p. 197.

appeal to personal and immediate sense perception displaced reliance upon symbols and abstract ideas. But, after all, to have sensations, to receive impressions through sight or hearing, is not the ultimate thing. To do, to perform, to execute, to make, to control and direct activity — it is for the sake of such things that perceptions and impressions exist. Indeed, to see and to hear is more than to have impressions; to see and to hear is to do, to *do in coöperation* with head, arm, hand, and leg."

Manual activities viewed from psychological and neurological standpoints.

Viewed from the psychological standpoint, manual activities yield elementary ideas which are essential to the development of any degree of complexity of mental processes. On the neurological side, according to modern theory, manual training is of immense value in the development of the motor regions of the cerebral cortex.[1] Balliet[2] has pointed out that manual training, requiring the coördination of eye and hand at the same time, knits together the cerebral areas concerned, and this results in a general betterment of the organization of the brain. Perfect sanity and mental health appear to require the establishment of associations between sensory and motor areas of the cortex, and manual training is best fitted to attain this end. Thought and deed must be intimately related to each other if life is to be properly balanced and con-

[1] See, for instance, Donaldson, "Growth of the Brain," Chap. XVIII.

[2] See his address delivered before the Massachusetts Teachers' Association at Worcester, Massachusetts, Nov. 30, 1895, and published by the Association, Malden, 1896.

trolled — if there is to be firmness and poise of character. But, continues Balliet, "much of our present school work divorces knowing from doing, and often exaggerates the relative value of the former as compared with that of the latter. Examinations test knowing more than doing, and even university degrees are conferred on the basis of attainment in knowing rather than attainment in doing. This may be to a large extent unavoidable, but it is nevertheless unfortunate. The legitimate end of knowing is doing."

Suggestions gained from the training of defective and delinquent children.

It is exceedingly suggestive that defective and delinquent children are helped most by manual training. Seguin,[1] as I have intimated above, has shown that in the training of idiots one must begin with the hand. The dull mind is awakened through the necessity of accomplishing some task involved in motor adjustment. Experiments in the treatment of young criminals in the Elmira reformatory reveal the beneficent influence of work with tools. Many instances like the following[2] are on record: —

"This is the story of Conscript No. 6924, who was assigned to manual training in March, 1897. This pupil came to the school from the third grade, or incorrigibles, having been sent there as a result of continued depravity. In the July following his admittance he lost ten marks as a result of continual

[1] See his "Idiocy and its Treatment by the Physiological Method," Wood and Co., New York, 1866.

[2] See the *Elmira Reformatory Year Book* for 1897, pp. 57–121; also Scripture, *op. cit.*, pp. 20, 22.

talking, laughing, and slovenliness, and for these offences he was reduced to the second grade, July 21, 1895.

"In August he lost ten marks, and was in seclusion three days. In September he lost eleven marks for malingering, carelessness, and talking. He was sent to seclusion again, this time for two days. In October he lost five marks for malingering and talking. In November he lost four marks, talking and laughing. In December he lost two marks for denial of legitimate report and for untidiness.

"In January, 1896, he lost eleven marks for conspiracy, etc.; in February he lost five marks for talking and slovenliness; in March he lost ten marks for talking and slovenliness. On April 2 he was sent to the third grade for treatment as an incorrigible, and remained there until June 25, when he was given a chance to mend his ways, and temporarily assigned as a laborer in the improvement squad to work on buildings then in course of construction. In August he lost one mark for wasting food. In September made a good record. In October he lost three marks, November ten marks, and in December he lost one mark, with the result of the modified treatment being withdrawn.

"In January, 1897, he was in the third grade (incorrigible). On March 6 he was assigned to manual training, Group II (Self-control Defectives), with subjects as follows: athletics and calesthenics, mechanical drawing, molding, sloyd, chipping, and filing; each subject one and one half hours per day, five days per week.

"Here begins a phenomenal change. The first month of his assignment he made a perfect record, and was restored to the second grade. From this time on there was a sustained effort to improve. The influence of intelligent, systematic,

and entertaining employment, based upon principles fundamentally correct, began to show fruit, and he grew up rapidly into personal respect, moral elevation, and responsibility. This pupil, for the entire time of his manual training assignment, four months and one day, did not lose a mark; also during this time his reports were only one second class report, two third class reports, and one labor report, or a total value of only eighty cents in four months and a day. This, in contrast to his earlier records of ten and eleven lost marks almost monthly, is remarkable. He was restored to lower first grade July 1, 1897, having earned promotion. He was graduated October 4, 1897, and retained in capacity of instructor in sloyd classes, and is doing well at this writing."

TOPICS FOR INVESTIGATION AND DISCUSSION

1. Did you have any manual training in your own education? If so, what did you gain from it? If not, did you have opportunity for manual activities outside of school?

2. Do the children you see about you to-day have opportunity for as wide range of manual activities as you enjoyed yourself?

3. Observe the children in your locality, and make a note of the occupations they are habitually engaged in that employ the hand.

4. Compare the city child with the country child in respect of their opportunities for manual activities.

5. Is there greater need for manual training in the schools of to-day than in the schools of fifty years ago? Why?

6. Ask the people around you what in their opinion should be accomplished in manual activities in the school. Do you agree? Give all the arguments in the premises.

7. Have you known children who were stupid in arithmetic and grammar but who were bright and efficient in all work requiring the use of the hands? Be specific in describing these children.

8. Will manual training in the schools take time from more useful studies? Argue the case.

9. If you can do so, compare pupils who have manual training with those who do not, and note whether the former are deficient in the common branches. Are the latter deficient in anything?

10. If you have opportunity, compare schools in which all pupils have manual training with schools in which there is none of this work, and note whether pupils seem happier and better controlled in the one place than in the other. Is discipline a more difficult problem in the one school than in the other? If you cannot make an actual test of the matter, what would you expect to find? Why?

DIRECTOR OF INDUSTRIES
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CHAPTER V

MANUAL ACTIVITIES IN EDUCATION (*Continued*)

Manual training must follow the lead of the child's interests.

WHILE granting the potential value of manual training, it should at the same time be recognized that, in order to accomplish its purpose, it must follow the lead of the child's interests, and must concern itself with *deeds*, not with abstractions or definitions. One may see work in this subject which is confined wholly to the theory of tools and constructions, and the making of merely formal objects. But this sort of work is little more real and dynamic than is geographical or linguistic theory and formulæ. The elaboration of a science of manual train ing is very apt to beget some such formalism in teaching as characterized instruction in arithmetic or grammar in an earlier day, wherein the beginning was made with definitions and logically elementary principles that were on the whole meaningless and uninteresting to the pupil.[1]

To repeat a point made above, the motor interests and inclinations of the young lie in the direction of reproducing by the use of suitable materials the activities which

[1] Since the above was written I have read an article by Hall, in the *Manual Training Magazine*, July, 1902, which emphasizes the point I have tried to make. I commend it to the reader.

are occurring in their environments. The child is ever seeking to adapt himself to his surroundings through imitation, and he strives then to copy the work of the carpenter and the blacksmith and the farmer, and others with whom he comes in contact. He has here valuable motifs given him by his imitative tendencies, to be realized through motor activities; and manual training ought to start at this point. It ought not to begin with logical abstractions which have not become meaningful to the pupil because of his experience and his native interests. It ought not to start with the theory of the use of tools; but theory, here as elsewhere, should be gained largely through actual experience. I cannot see that the theory relating to the manipulation of a saw, for example, can be apprehended any better when taken by itself apart than the theory of arithmetic without weighing and measuring and buying and selling, or the theory of language without speaking and writing correctly and effectively.

The logical *vs.* the psychological order.

The manual training people, some of them, have fallen into a very common educational error. They have developed their subject quite apart from the real life of the child. They have begun with the logically simple and proceeded to the logically complex, regardless of the interests of the pupil at different stages in his evolution. One must learn elementary facts before he can appreciate complicated objects, say the specialists, as well in manual

training as in other studies. A child cannot use tools in making a box until he has had a great deal of instruction in the use of saw and hammer and plane; until he has learned how to make working drawings, and, in short, has mastered all the simple processes involved in the construction of any complex thing. So it is a long time, according to this régime, before the child really makes an article in which he is genuinely interested because it ministers to some need in his daily life. The specialists in music formerly proceeded in the same way in teaching their subject. The pupil was kept, and in some places is still kept, for that matter, for a long period on technique before he was permitted, or at least encouraged, to express himself through musical sounds. So the drawing and writing teachers insisted upon years of drill on formal elements before the arts they taught could be employed by the learner in any interesting or helpful way.

But we are growing away from this practice to-day, in respect of some of the studies at any rate, for, as I have indicated elsewhere, we are appreciating that technique can be best acquired in connection with a mastery of the content which is to be expressed by means of it; and elementary formal factors may usually best be ignored as distinct elements, requiring separate treatment. They must all be fused together into a unity, by employing them as a whole in *doing something requiring their use*

in this way. Kirkpatrick presents the view of modern psychology when he says[1] that, "In the history of the race . . . men have learned to do things, then reflected upon how they do them, analyzed to discover elements, then determined the general laws according to which the actions may be successfully performed, and this order of procedure is the natural one to the child. . . . This is true, not simply because of the general tendency of the mind to develop in this order, but because the past experience of the race has developed a very definite system of relations between various stimuli and various simple movements, and has probably developed less definitely various combinations of simple movements and a tendency to other combinations in the attainment of ends frequently striven for by the race. The teaching of a movement by having each of its elements learned, and then having these elements combined and used, is not only a reversal of the natural order in attaining an end and a misdirection of attention, but is an undoing of what has been partially done by the experience of our ancestors, instead of completing the process."

The individual must follow the racial course.

We do not solve all our problems, of course, when we decide that the child must acquire his arts and his knowledge in the general manner in which these were elaborated by the race before him, the method which Spencer[2] empha-

[1] See his "Education," Chap. II.
[2] *Psych. Rev.*, Vol. VI, p. 281.

sizes so strongly. Just how has the race acquired its arts? What is the racial order of development? these questions are in dispute, as to the details at any rate; but the large facts appear to be fairly well established. Professor Dewey [1] has given us a regimen which he thinks is faithful, alike to the racial order of industrial development and to the interests and capacities of the child.[2] The theory is that the child in his individual development recapitulates in his interests the industrial history of the race. At a certain period in his development, then, he will be interested in the typical activities of agriculture, for instance, and his manual work should be adapted to realize this interest. He should be given an opportunity to reproduce the characteristic work of the farm, starting with the most primitive modes of tilling the soil, harvesting the crops, and the like. In separating the wheat kernel from the stalk, for example, the flail was used before the threshing machine, and so the pupil must begin by making a flail. Then there will be dressing of dolls in clothing appropriate to farm life. Modes of transportation will be worked out; and implements to carry on the work of the farm must be made, — wagons, measures of various sorts, sacks, and barrels. The preparation of grains for food requires the child to work out methods of milling and

[1] See his "General Principles of Work," Elementary School Record, No. 13.

[2] The plan is worked out in detail in Miss Dopp's "Industries in Elementary Education."

sieving. In like manner he must construct devices for the making of butter and cheese, the working up of wool into clothing, and so on. In the course of eight to twelve years, following this plan, he will have repeated the main forms of the activities of the race in its conquest of nature. Manual training at any point in his progress will be merely a means to an end, and that the realization of the constructive passion of the child, which enables him to grow into an appreciation of what the race has accomplished, and prepares him to make advances thereupon. The sequence in manual training, according to this scheme, is determined by the constructive interests of the pupil, which in turn depend upon his interests in the various activities presented in his environment, and not by the logic of the subject, when the two sequences do not correspond, as they certainly do not in the beginning.

What does it mean to go from the simple to the complex in manual activities?

The pupil must, of course, begin with relatively simple activities. He must have tools that do not require difficult coördinations in their management, and he should not be asked to make complex and elaborate articles. If he follows the phylogenetic order in the tools he uses and the objects he makes, he will be progressing constantly from things simple to things more complex. Thus when he is passing through the hunting period, so called, he will make the implements which have been successively employed in this activity, beginning with the club, say, and

passing on in order to the sling shot, the bow and arrow, and lastly firearms.

As he progresses in his work the pupil will need to make use of more and more complex tools, and in this he will follow the racial course of development. Woodward[1] has shown that every tool has had a history; and like everything else it was relatively crude at the start and capable of being used only in coarse work. But in the process of development it becomes constantly more refined because it is being put to more delicate and highly coördinated uses. The development of tools follows the development of mind; as mental processes become more complex man must constantly remodel his environments, working them over into more complex and elaborate organization. One cannot conceive of the mind developing continually while the environments remain unchanged; the internal and the external world must evolve together. Mind grows for the purpose of working up the objective world into more and more complicated forms, so that it may sustain a more and more complex organism; and this means that with mental development tools and manual processes must become ever more complicated.

The manual training specialists are likely to err in thinking that simplicity viewed in a pedagogical light means merely structural homogeneity. A sphere accord-

[1] *Op. cit.*, p. 881.

ing to this view would be very simple compared with a chair or a house. But a perfect sphere, or the most *æsthetic* sphere, is a very complex thing for a child. He cannot easily apprehend or construct the æsthetic characteristics of things, for these always demand relatively great coördination and attention to minute details. A child can work harder in making a sphere than in making a chair or even a house, if he gives his attention to the characteristics of *use* only in the latter. I have indicated elsewhere [1] that children at first pay little heed to the æsthetic aspects of the things they use or make; the service of objects in ministering to vital needs is mainly considered, and crudity will serve as well as refinement in attaining this end. The child makes his doll house and his furniture therefor with reference largely, and it may be wholly, to the way in which they are to be used, and he is not particularly concerned with the artistic appearance of his handiwork.

H. at six years would frequently bring to me an armful of furniture which she had made in her workshop, and every piece showed clearly enough that there was a good conception of the use to which it was to be put, but there was little if any account taken of the æsthetic characteristics. Rough, crude, ugly appearances, viewed from the adult's standpoint, suited H. very well. In the making

[1] See "Children's Expression through Drawing," Add. and Proc. N. E. A., 1897, pp. 1015–1023.

of a doll's sofa, for instance, which H. frequently did at this age, she would use a couple of pieces of rough boards for support, nail another on to these for a seat, put on a back, and the thing was complete. She would reveal hardly any desire that the various parts should harmonize with one another in any æsthetic way; use alone occupied her serious attention. And what was true of the sofa was true of all the articles she made at this time. However, now in her ninth year she is paying considerable attention to *appearances.* Things are pretty or fine or ugly or horrible, and the like. Use is still, of course, an important attribute of the things she constructs, but these other qualities are being added, and this makes her problem continually more difficult and more complex. Complexity is not so much a matter of objects as of the *way in which they are regarded.* We need have no fear, if the child be permitted to make the objects which are of predominant interest to him at different periods, that he will be attempting too complex work; rather we are to avoid forcing upon him logically simple things, and endeavoring to have him realize adult æsthetic conceptions in their execution.

Crude work first, æsthetic work last.

In our manual training, then, we must plan it so that the pupil will at the start do coarse, crude work that interests him, emphasizing the quality of use. When he reaches the high school his work should be of a complex character, which should require much more elaborate and accurate

coördination than the young child is capable of. Of course, if the pupil be permitted from first to last to produce only crude articles, his progress will be impeded. A pupil who works in the same coarse way in the fifth grade that he did in the first is losing his chance of doing work of a higher quality. All his mental and motor processes will become arrested at this stage of development. A boy put to blacksmithing at twelve and kept at it may develop power in this special activity, but he will be found wanting if he be put to the test of performing finer coördinations in sewing or similar actions.[1]

The doctrine of formal discipline through manual activities.

This will be the best place to point out certain limitations to the serviceableness of manual training in education. It is to be feared that there is a tendency in some quarters in our day to overemphasize the value of this work, which cannot serve the best interests in the long run of the movement itself. To begin with, I cannot see the reasonableness of Professor Scripture's view[2] in its implications, — that training the will in a motor direction results in the development of a general will power which may be exercised without loss of vigor in the accomplishment of all tasks whatsoever, whether intellectual, moral, or motor. This seems to be true only in the sense that the exercise of volition in any way doubtless does accomplish

[1] Cf. with this Harris's view of arrest in mental development, "Psychologic Foundations of Education," p. 142.

[2] See the *Manual Training Magazine*, December, 1899.

something toward the establishment of a general habit of voluntary effort and control; and it is of value also in so far as it augments the stock of cerebral energy which may be drawn upon for the support of volition on any occasion. But this does not argue that manual training is of peculiar value in the cultivation of will power; the energizing of the will in dealing with any sort of problems leads to these general results.

Conscious effort in a particular direction, however, cultivates the will especially in that direction, and not in all directions. Experience has not shown that a carpenter or a blacksmith has greater power of discharging the duties of a statesman than one who has in the past exercised his will in this special field.[1] Indeed, manual laborers are not distinguished for their will power in any department of human activity except their own. We should infer from current theory respecting the methods of neural action, that exercise of any special kind would furrow out channels for the discharge of energy in support of just this kind of activity, but not an activity of a different sort. Will would become strong, that is to say, in reference to activities of this particular character; but in expressing itself in any other way it would have to open up

[1] The author has discussed the principle in detail in his "Education as Adjustment," Chaps. XIII and XIV. Compare with this the following: Thorndike, "Educational Psychology," Chap. VIII; Bolton, "Fact and Fiction in Educational Values," *School Review*, February, 1904; Swift, "The Psychology and Pedagogy of Learning."

new routes, and what had been achieved in the first kind of action would be of no particular account in the present situation. So we are not to believe that manual exercise offers any better facilities for the general training of the will than does any other experience which requires an equal degree of application; remembering, though, that in the early years the organism gives itself most naturally to motor activities, while in the later stages of the developmental process the will may operate in coördinating ideas that do not find immediate realization in muscular action; and this is as legitimate and as necessary a function of volition as directing the hands.

The principle illustrated in athletics.

The large principle involved here is illustrated, I think, in the effect of athletic experience, as a form of motor exercise, upon the intellectual and moral life. It is a matter of common belief that a man may face death on the battlefield without flinching, but conduct himself like a child in the dentist's chair. It is reported that in a recent football game some of the leading men in the team that was defeated lost control of themselves emotionally, and bawled for hours afterward. It is quite common to hear of athletes breaking down when they have lost a game; the physical courage bred on the athletic field does not stand them in good stead when they face situations where muscles will not help them out. A man who has little courage in the rush line often has enough philosophic courage to stand defeat heroically in the ordinary situations

of life. Again, every one has known men of great physical valor who would almost forget their names through fright when they arose to address their fellow-citizens. On the other hand, men who would without a tremor face an audience would not face a center rush in a football match under any conditions. Pugilists must have a great stock of brute courage, but can they use this in the social, moral, and intellectual situations in which they are placed? A certain quondam champion pugilist of the world is to-day nothing but a common drunk and street brawler. It is not recorded that in the class room in college or in the affairs of life outside, the crack athlete is any more honest or frank or quick or patient under tribulations than the rest of men.[1]

So one might go through with the whole catalogue of physical virtues, and it would probably appear that they cannot be utilized at face value in social emergencies. A student in the class room in college, as well as on the football field, has occasion to use honesty, and to be alert and frank, and to take hard treatment philosophically, and to keep his temper; and one thus trained in the class room can employ his training to better advantage in situations in life like those presented in the class room than can the man who is trained principally on the gridiron.

Physical virtues applied to social situations.

[1] Dean Briggs makes some interesting comments respecting honor among college men, — athletes and others, in his "School, College, and Character," which see.

It would not be wise, then, to give physical contests of any sort a prominent place in planning a curriculum for the development of virtues needed by an individual in adjustment to his fellows in all the complex affairs of social life, though granting that they should have some place. They will be most serviceable, doubtless, if they come early in a pupil's development, for they put him in relatively simple and crude situations with respect to the exercise and development of the virtues of bravery, and the like. These more or less physical qualities must probably come before those of a more spiritual character in the individual's development. Courage in the face of possible physical disadvantage naturally precedes courage to tell the truth in a business pinch when a lie will bring some temporary advantage. In one's ascent toward the goal of upright, honest, courageous, social living he is compelled to pass through periods when he must exercise the simple and largely physical qualities which are, in a way, the progenitors of the social qualities which will be needed later. The theory is that the higher qualities will be more vigorous if the earlier ones have been developed; the higher absorb the lower, as it were, by using the energies which have been generated to sustain them.

I speak of this principle as it is involved in athletics because most of us have experience enough to appreciate its operation in this field. But it applies equally well to manual training. And this leads to the last word on this

subject. With the progress of the child through the schools, manual training as a form of motor activity should occupy a less and less important place, except for those pupils whose wills in maturity are to be manifested primarily in energizing and coördinating muscular action. A boy who is to be a carpenter should continue in all stages of his educational course to make manual training of this sort his most important occupation. But a boy who is to deal with questions of jurisprudence or medicine or education will suffer arrest in his evolution if he be kept too long and continuously at work with his hands. His will must come to habitually express itself with ease and efficiency in a different way from that of the carpenter. But if during the entire developmental process his energies be expended most largely in manual activities, and not in thinking of a sort not expressible in this manner, it seems certain that in maturity he will react easiest along the lines of hand rather than of head work. This does not mean, however, that manual training should ever be entirely abandoned; it means simply that in the higher departments of education it is to receive less and less emphasis, except for those whose life work involves continual use of hand rather than of head primarily.

With development manual must give way to mental activities.

TOPICS FOR INVESTIGATION AND DISCUSSION

1. Point out the difference in method of procedure in teaching manual training dynamically *vs.* statically.

2. Should manual training be presented at the outset as a science or as an art? What is the difference between the two?

3. Observe the children about you with respect to their manual activities. What sort of objects do they spontaneously construct?

4. When do individuals begin to take an interest in making perfect type forms? Have you noticed whether children are interested in attaining mathematical and æsthetic perfection in any of their activities?

5. What is the psychological order in presenting manual training? What determines this order? How does it differ from the logical order?

6. Show how you could in manual training permit children to begin with the construction of such apparently complex objects as a bookshelf and a sled, say, and at the same time train them in the technique of their art, using each tool employed in the most efficient and economical way, "hewing exactly to the line" always, and so on.

7. Would you ever criticise a pupil's work because it seemed crude or inexact, provided he had worked out after a fashion the idea he had in mind? Give your reasons in full.

8. How would you correlate your work in manual training with the rest of the work of the school?

9. Should manual training have as important a place in the high as in the elementary school? What are the arguments pro and con?

10. What would you say to an enthusiast in manual training who declared that it trained character better than other studies, and so ought to have a more prominent place in the curriculum from first to last than any other subject?

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CHAPTER VI

THE METHOD OF ACQUIRING ADAPTIVE ACTIVITIES

The helplessness of the infant.

THE world which the infant enters at birth impinges upon him in countless ways, physical, social, æsthetic, but he does not react upon it except to express his discontent, as many think, in an extremely general way, and to swallow his food which he finds ready at hand. If he had any desires or ambitions with relation to his environment (and happily he does not seem to have), he would be utterly unable to realize them. He is as a ship adrift: the winds and the waves send him hither and thither, as they will. He is dependent absolutely for his existence upon the services of his elders, who have learned how to adapt themselves to the forces acting upon them. He is far more helpless at birth than the chick or the calf or the colt or the kitten or the puppy. Yet he is not static; on the contrary, he is in action most of the time during waking moments. But his activities, except in a few instances, have no purposeful relation to the world about him. They are simply *impulsive*, to use Preyer's term: or one might say *spontaneous* with Bain, Miss Shinn, and others. Even before birth there are activities of this

character;[1] they occur in the embryo before the reflex mechanism is capable of functioning, so they cannot be of the nature of reactions upon an environment in an effort to become adjusted thereto. These primitive movements are probably due to the more or less spontaneous release of energy, generated during the process of metabolism, in developing nerve centers. Höffding[2] calls attention to the fact that the simplest organisms have power of moving without being stimulated from without. Internal changes liberate energy, as in the case of the amœba. This power is possessed, he says, by all organic cells. But the occasion for speaking of this kind of movement at all must not be lost sight of; it has no direct reference to adaptation to an environing world, although, as we shall see, it furnishes the data out of which adaptive activities may be developed.

During the first twelve or fifteen weeks of the child's life, and for a longer period possibly in many cases, a variety of stimulations keep him in action a considerable part of the time, but yet one could hardly say that he was

[1] See, for instance, Preyer, "The Mind of the Child," Vol. I, p. 201 (New York, 1888). In his observations on the development of the chick, Preyer found that movements occurred which must have been incited from within; there was no external stimulus to arouse them, for they appeared without any alteration in the surroundings, as he thought. One can appreciate, however, that it is almost impossible to determine whether the surroundings of the developing chick are kept absolutely uniform.

[2] "Outlines of Psychology," p. 308.

reacting upon his environments. Rough clothing, for instance, will incite activity in the child's legs and arms and vocal organs, but these are not intelligently and specifically related to the source of his troubles, though there may be a sort of blind confidence that by kicking and crying relief will be obtained. Looking at the matter neurologically, we may suppose that dermal irritation liberates energy in the central nervous system, and this runs out through the channels which have been employed heretofore in the production of very simple and very general impulsive movements. It is not confined to just the route that will lead to adaptation to the particular forces now acting on the child. The infant's reactions are practically all characterized by lack of definiteness, of specific appropriateness which would make them effective. Observe a four-months-old child when he beholds his mother after a period of separation. He is very evidently eager for her to take him in her arms, but he cannot do much on his own part toward bringing about the desired end. He is active enough, but his actions are not properly correlated with the object arousing them. They are riotous, chaotic, not purposeful or adaptive, except in the most general sense. From one point of view there is method in his madness; but if he had not been cast amid friends who are alert to catch every expression so as to serve him, he would fare badly indeed. The infant instinctively expresses pleasure and displeasure, but he

must wait upon others to decipher just what he desires and to minister to his needs. He can do nothing but make his wants known in a very coarse, nonspecific manner.

All students of mental development have noted this first epoch in the child's career. Whatever actions he performs that appear to have rudimentary intelligence in them are after all of a spontaneous or reflex character. His hands roam about aimlessly, or with only the most general aim of encountering some object accidentally, and when they come in contact with an object they set out with it on the journey to the mouth. But he is probably quite unaware of precisely what occurs, and not at all responsible for it in any conscious or volitional way. It just happens; and he is in all likelihood not even an appreciative onlooker, at the outset.

Morgan[1] can hardly have an inexperienced babe in mind when he says that as he is "gazing about here and there, a sweet is brought within his range of vision. So soon as it falls within the margin of the visual field, the eyes are so moved as to bring it to the focus of vision; the hand is even stretched out to touch and seize it, and it is conveyed to the mouth." Such an act would be impossible without a great amount of preliminary experience[2] of a kind to be described presently. We must not

[1] See his "Psychology for Teachers," pp. 55-56.

[2] The earliest I have seen an infant perform a purposeful act was in the fourteenth week. Then she placed (in a faltering and uncertain

confuse the child's accidental successes with purposeful, deliberate action.

For a number of weeks, then, the child's activities are wholly spontaneous or reflex. They seem to go on of their own accord, all running in a few instinctive routes; they are not in any respect controlled by the needs of adaptation to special situations. But by the fourth month, say, there are evidences that some correlation between particular impressions and appropriate reactions thereupon is beginning to take place. At the outset, this correlation comes about in an accidental manner. Complex series of data chance to get into consciousness at the same instant, or in immediate succession, and they adhere together in this way, making a pattern of experience, let us say. There may be data gained from vision (*a*), including some objective point, as the bottle of milk and the appearance of the hand in reaching it; then there may be data gained from extension of the arm (*b*); from touching the object (*c*); and grasping it (*d*); from bringing the hand to the mouth (*e*); and gustatory data (*f*). Now these partial processes tend to stick together in this

The first step in gaining adaptive activities

way, it should be added) both hands upon her mother's face while she was looking at her. This was not mere accident, for the act was repeated several times in the spa.. of a few minutes, and there was not much random movement accompanying this. It is, of course, extremely difficult to tell just when such a deliberate act occurs for the first time, since the child may accidentally hit the mark, and the observer is likely in such a case to be deceived.

particular pattern (*a-b-c-d-e-f*), which has proved serviceable in adaptation, and the disposition will be for the pattern to become completed whenever the first factor thereof (*a*) comes into consciousness.[1] Of course, it is a long process, full of strain and struggle, before this complex act will become so definitely established that it may be performed readily and with absolute certainty. It should be remembered that the child's earliest reaction upon his bottle was a general activity of his whole body, arms, features, vocal apparatus, trunk, and legs. The visual datum (*a*) liberated energy which apparently stimulated the entire nervous system. But in acquiring this adaptive act the energy must be directed into particular motor channels, and in a certain sequential order. The first reaction is a very general one; the second is a specialized or particularized one. And the process of specializing in motor acts consists in directing the attention upon certain special data of experience gained originally through spontaneous execution. Four-months-old children can be observed watching their hands for several minutes at a time as they wander about more or less mechanically. If they chance to come in contact with an object they

[1] In my "Education as Adjustment," Chaps. IX and X, I have discussed the principle of dynamogenesis — the tendency of all stimulation or impression to produce motor response. Now the particular response which any special impression will produce is determined by the pattern of which it is an element. This point will be worked out in detail in the course of this chapter.

reflexly start with it for the mouth. Now, adaptive action is just beginning to be established in this simple experience. The data furnished by the eye get connected with those derived from the hand and arm in the process of grasping an object, and conveying it to the mouth, and also with those derived from the events transpiring at the terminal station, because these data have been gained simultaneously or in immediate sequence. All data tend upon repetition to coalesce, forming a simple reactive system, — impression and motor response which brings the organism into advantageous relations with the object yielding the impression. When the year-old child sees his bottle, say, this stimulus releases in order the actions which have previously given him pleasure; there is no longer mere muscular excitement or fruitless action.

It needs to be impressed that this adaptive action is not learned in a day; it is a matter of months, not days. One may observe a child acquiring the ability to deliberately grasp an apple, as an instance. Passing over the purely accidental stage in his first essays, we may note that in the beginning of voluntary control his hands move out in the general direction of the object, but he has not yet learned to make precise adjustments. He is likely to go wide of the mark, to overshoot or undershoot, and he does not know how to correct his mistake. He first makes a *general* not a *precise* or *special* adjustment. The parent must put the apple in his hands. But day after

day he keeps trying, ceaselessly trying, and noting in a more or less distinct way[1] the outcome of various acts; and to state the principle in a general way, by selecting the adjustments and repeating them, he grows in efficiency until in time just the right processes come to prevail over the useless ones, and the complex adaptive act is learned.

Bain[2] has said that the chief requisite in the development of deliberate out of random movements is that the attention should be directed upon the *method of performing* a given movement (which occurs first spontaneously) and its outcome. This results in fusing into a system or series a number of inherently unrelated events. Then later when attention is directed upon what was originally a separate term of the series the whole will tend to become reëstablished. But it is not quite correct to say that the learner must attend primarily to the *motor processes* involved in performing an action; it appears rather that he must be mainly conscious of the *object to be dealt with*, which includes the object as a thing of perception, and its value for the individual. The motor adjustments are

[1] Of course, the learner's ability to attend to the details of an act he is learning must at the outset be very general and nonspecialized. He probably cannot "see" in a much more particularized way than he can execute, though the *modus operandi* of accomplishing an accidental act may to some extent doubtless become consciously apprehended.

[2] See his "The Emotions and the Will," p. 309. Cf. Baldwin, "Mental Development, Methods, and Processes," Chap. VII, especially pp. 180–204. Also Bair, "The Development of Voluntary Control," *Psych. Rev.*, September, 1901.

at first largely represented in consciousness as kinæsthetic feeling, and this speedily becomes marginal. The principle is illustrated in the case of an adult learning golf or tennis. At the outset he gives a certain amount of focal attention to his stance, the manner of grasping the club or racket, the serving, and so on; but very soon these processes are lost sight of, and the player simply *keeps his eye on the ball.* As one observes children learning to adapt themselves to the world, every sign indicates that they are for the most part conscious only of objects to be dealt with and their values; and the muscular processes required for adaptation get selected in a more or less subconscious way.[1] Of course, viewing the matter logically the learner must take account *focally* of all his movements, and note which succeed and which fail; and while this is doubtless true of much that he does when he reaches the reflective stage, when the ends he wishes to attain require very complex adaptive processes, still it does not appear to be so important at the outset.

[1] However, Bain cites an instance of movement claiming explicit attention — the moving of the ear — which, it is easy to see, might, if it should occur spontaneously, be sufficiently novel to attract attention. There would be no objective end toward which the movement would be directed, and so attention could occupy itself wholly with the sensations arising from the movement itself. But such actions as this are of such slight importance that they may be left out of account, and the principle may stand, — that in deliberate action in the beginning the attention of the learner is devoted mainly to the ends to be attained, and not to the means of attaining them.

A concrete instance of acquiring adaptive movements.

In V.'s twentieth month I tried one day to get him to imitate me in throwing a ball toward the ceiling. He had had experience in tossing a ball, and it had often gone in the direction of the ceiling, but probably always without deliberate attempt to send it there. Now when he *tried* to do this particular thing his arm became rigid, he could not let go of the ball at the proper moment, and when it finally was released it went toward the floor. He made a great effort to do it, as was apparent from the tension of muscles in his face and body and of the hand not used as well as the one employed. He kept at the task for several minutes, and as the muscles became less tense and the ball was released more readily he succeeded in giving it an upward direction a few times, though it did not reach the ceiling in any case. Nevertheless, he was greatly pleased at his partial successes, and he wanted to keep trying it. The test was repeated every day for some time with the result that at the end of four weeks there was no longer any doubt but that he had acquired the ability to throw the ball up *when he wished* to. Most of the original strain and tension and excess movement had disappeared, so far as I could tell.

I tried V. at about this time in executing other simple acts which he had never performed deliberately; for instance, in turning a key in a door lock. He apparently regarded me carefully while I turned it, and then he took hold of it and pushed it in and out. He was unable

to reproduce just the thing he observed. He probably saw *only what was nearest to what he had previously done.* When he took hold of the key his reaction was pulling in and out, because this was the sort of reaction that had occurred in similar situations in the past. After he made a number of unsuccessful trials I took his hand and turned it for him and repeated it a few times. Then he caught the idea and worked away by himself, pulling in and out more than turning at first; but he had the notion of how the thing was to be done, and it was not long before he was master of the art. These examples are typical of well-nigh innumerable instances I have observed, all conforming to the same general principle of learning.

Learning involves excessive activity.

In the acquisition of any new act there appears to be an excess of action involving muscles which should remain quiescent, or practically so. The novice is unable to energize just the muscles in just the coördinations he wishes; new actions must always be differentiated out of a mass of more general activities. When V. was learning to throw the ball up, much of his fundamental muscular system appeared to be in action, and the same thing could be seen when he was working at the key, when he began to write, and so on *ad libitum.* The novice is lavish in the expenditure of energy; and looking at the matter neurologically it would seem that the purpose of this is to cause an overflow from old channels into new ones, so that new activities may get started. Many of

the activities occurring in the excess display are apparently irrelevant, since they do not seem to be related at all to the one aimed at. However, as a result of this excess, the adjustment desired may accidentally appear, and if it gives pleasure it will make a deeper impression than the others, and so will be hit more easily in future trials. Of course, the process of differentiating the special movement from the original complex must be a very involved one, and this explains the difficulty of the child's acquiring any art, even so simple a thing as winking or sucking through a straw, so that he can do it with certainty and without excess or waste.[1] Learning new adjustments, let it be repeated, consists mainly in differentiating special movements from a general body of movements in which the special ones are embodied. The reason the child cannot wink deliberately with one eye when he first makes the attempt is because this has no distinctive meaning or existence in consciousness. He has a wink-both-eyes idea, using a popular term; but he has no wink-the-left-eye

[1] Bair, *op. cit.*, pp. 506–510, illustrates the principle by experiments upon adults. He gives the results of investigations upon energizing the muscles which move the ear. He first moves it mechanically, which gives the subject some impression of how it feels. Then the subject, endeavoring to enervate the special muscle, enervates a number of other muscles about it; but through direction of attention upon the peculiar sensations of the ear movement this gradually becomes more permanent than the others, attention gets the power of isolating it until finally it can be enervated by itself alone. This is exactly such a process as can be observed in all the child's learning.

idea. So he has a general purse-the-lips idea, but no suck-in-with-the-lips idea. The principle has universal application in every stage of mental development. The adult learning to pitch a curved ball has a project-straight-ahead idea which will enable him to send it forward, but he lacks the simple-twist-of-the-wrist idea which will give his ball a rotary motion. This he must get as a process of specialization of the general projecting movement. The same is true, of course, of his learning tennis or billiards or golf or any manual art. Take again a man learning to pronounce German, say *Ich*. He gets the fundamental combination, that denoted by *Ik* perhaps, because this combination is nearest his experience, but he misses the peculiar element which differentiates *Ich* from *Ik*. Any one who has studied German or French, or better still who has taught either, will have numerous examples to illustrate the principle. So look where you may you will always see an individual, be he young or old, who is learning an act of any kind trying to differentiate the special coördinations which make it new from the more familiar and general processes in which they are incorporated, so that the new one may be executed without all the unnecessary accompaniments.

It seems that nature has taken pains to provide all young things that have to *learn* activities, that do not live out their lives on the plane of instinct as the chick does, — she provides all *learners* with a tendency to be incessantly

The integration of simple acts into more complex adjustments.

in action, some of which is apparently purposeless; but out of this exuberance will come in time something of worth. There appears to be no way to secure advance except through experimentation, or play perhaps, or curiosity.[1] It should be noted further that as the individual discovers higher and higher activities, the lower ones decline to a certain extent, or become subordinate. S. greatly enjoyed reaching for his mother's face from the beginning of the fourth month on, but after the seventh month he seemed to be less interested in this activity, but spent most of his minutes at mealtime engaging in little games, as bo-peep or something of the kind. The original action occurred thereafter only as it was one of the factors in a more complex series constituting some game; and the example is, I think, typical of most of the activities performed throughout the whole of the developmental period. It seems that when one is mastering an activity he repeats it in practice only until it can be performed with surety and ease. When the child begins to walk he soon abandons the original creeping movements which he once practiced so enthusiastically. At eighteen months the child is practicing running and climbing stairs and tearing paper; but at five years he does not engage in these activities except as they have become elements in more complex ones. The child of five runs to catch people

[1] The educational implications of this principle seem very important and will receive due attention later.

or to run away from them, or to roll a hoop, and so on, whereas in the beginning he practiced running with no ulterior end in view.

At eight H. is busy a good deal of the time in reading, playing at society with her companions, caring for her doll, cutting patterns out of paper, producing designs with her paints, using her pencil in drawing, and so on. At three years there was little interest in activities of this sort; instead she was climbing and running and pounding, and, in short, using her muscles in all manner of ways for the mere pleasure of exercising them in the accomplishment of simple feats. But now she has reached the point where she can perform these simple tasks very easily, and she seems to have abandoned them. The principle is illustrated in the use of language. By the twelfth month or thereabouts the child's vocalizations occasionally correspond to some of the words spoken in his environment, and with the aid of his elders he detects the resemblance. Then he repeats the combinations continuously until they are mastered, when he lets them go. But whenever he makes a new conquest of the words he hears about him he keeps going over them until they are fixed in habit. And this tendency is seen at every period of life. Even an adult is apt to repeat to himself a strange word until the vocal mechanism becomes adapted to express it readily. At eleven years activities which were very prominent at eight have again been supplanted by

others more involved, more intricate intellectually and socially. And so development works on, carrying the individual ever upward into more complex adjustments, making what is valuable in the present secure in automatic action, and providing for constant growth by causing the *new* task to appeal with great force to the individual so that it will receive his attention.

Nothing is learned *de novo*.

It should perhaps be said in qualification of what has gone before, that it is impossible to conceive that the child could learn absolutely *de novo* such adaptive movements as have been referred to. The experiences of the race in correlating movements appropriately with the world without must prove of incalculable advantage to the individual in his own learning. We have seen that the child inherits a few definite adaptive movements; and why should not the basis for others be inherited, so that with a small amount of experience they may be made definite? One can hardly imagine how the child could so rapidly become possessed of such a vast number of adaptive movements if there had not been some preparation made for him by his ancestors. It seems probable that many, perhaps most, of the child's serviceable actions which he appears to acquire *ab inito,* are really in the process of becoming reflex in the race, although, as a matter of fact, only a few have as yet reached this advanced stage. A certain amount of experiment is essential in order to make these latter effective, but something has already been

accomplished; the routes have been established, and they need only a little smoothing out to make them passable — some much less than others, of course.[1] If one will follow a child day by day from birth onward he will see adjustments being learned so speedily and with the detailed steps so obscured that he is forced to the belief that there must have been a considerable amount of internal preparation for these adaptations. It is inconceivable that experience alone could accomplish so much in so brief a time, or with such slight emphasis upon many of the details of learning. It is suggestive to compare the speed with which the child makes some of his very complex adjustments with the laborious way in which the schoolboy masters the relatively simple acts of writing and drawing, which have been invented so recently in race history.

TOPICS FOR INVESTIGATION AND DISCUSSION

1. Have you ever observed the differences in the abilities of the young of lower animals and their parents? See if you can tell what a hen can do that its newly hatched chick cannot. What can a dog do that its puppy cannot? In the same way compare a cat and its kitten, a horse and its colt, and so on.
2. How long is a chick helpless so that it must be cared for

[1] See Kirkpatrick, "Development of Voluntary Movement," *Psych. Rev.*, Vol. 6, pp. 275–281 (May, 1899). Also Baird, "The Influence of Accommodation and Convergence upon the Perception of Depth," *Am. Journ. of Psych.*, Vol. 14, pp. 150–200 (April, 1903).

by its parent? Speak in the same way of the puppy, the calf, the colt.

3. How long must the human child be cared for by its parents? What is the significance of this long period of immaturity in the human species?

4. Would it be an advantage or otherwise if the child came into the world ready to take care of himself in most respects?

5. Could you speak of the child's earliest activities as adaptive? Why?

6. Point out the most marked differences between the activities of a month-old and a ten-year-old child.

7. Show why a child cannot place his hand on his mother's face the first time he makes the attempt.

8. Have you learned to write the Greek or German script? If so, did you make each letter exactly right the first time you tried? Explain fully your experience.

9. Could a child of five learn to write German script as readily as you could yourself? Why?

10. Why does not a child of five, say, continue to do the same things over and over again all his life? What is there about the normal child that makes him different from the idiot in this respect?

CHAPTER VII

THE METHOD OF ACQUIRING IMITATIVE ACTIVITIES

In the preceding chapter we glanced at the development of that variety of adaptive movements that enable the individual to deal accurately and effectively with the objects in his environment. For the most part these movements have to do with obtaining or avoiding or manipulating things, though some of them, as jumping, for example, do not appear to have such an end in view directly. Still even in this last sort of action the child seeks to bring his body to a given point; and this amounts to his trying to secure the point as an external thing. Keeping in mind the general principle, we must now turn to adaptive activities of a somewhat different character. If one will make up a face before a child of three who is not deeply engaged at the moment it will probably be imitated at once more or less completely, and commonly without deliberate intent on the imitator's part. His action is a sort of echo. When children are beginning to talk, at two years or so, they often repeat the words they hear about them in a parrotlike way, seemingly as mechanically as a musical instrument will sometimes re-

The phenomena of mimicry.

produce tones of the human voice. And I speak of language merely as a typical activity.

The phenomenon in question is altogether too familiar and has been too generally described by numerous writers on mental development to require many instances in illustration, though Mr. Cooley has recently taken exception [1] to the prevailing view that children are great imitators. He thinks the child likes to be let alone to work out his own ideas. But where do his ideas come from? Of course, every normal child wishes to carry out his own undertakings; he does not like to have an adult or any one else break in on his activities; but this does not mean that he is not an imitator. It simply means that he desires to be left free so that he may imitate, that he may really by his own effort reproduce in his own way what is going on about him. He does not want some one else to do his imitating; this, I think, is the explanation of his resistance to adult interference. It is clear that, considering the needs of adaptation, imitation is of the utmost consequence, and the tendency to imitate seems to have been carefully provided for in the instinctive equipment of the individual. It does not alter the case to say that it is largely a subconscious affair, which it undoubtedly is. The child does not usually copy the people around him for the conscious end of assimilating himself with them, but nevertheless he becomes adapted thereby just as effectively as if he deliberately planned the business.

[1] In his "Human Nature and the Social Order," pp. 18–28.

When does imitation begin?

All observers agree that there is probably no imitation during the first three months of life. Some have detected what they considered to be imitation at the beginning of the fourth month, but in the case of the children I have observed the first clearly imitative act of which I could be sure did not appear before the seventh month. True, one may chatter to a four-months child, and he will respond in kind, but it seems likely that his chattering is simply one form of a general motor excitement. The arms and legs, as well as the vocal organs, will be actively in motion. And then the chattering may often be heard when the child is playing with his rattle, or even lying on his back and regarding the ceiling. It is easy to be deceived respecting the child's first imitations, for when he is much stimulated and is running through the whole gamut of his motor accomplishments, as he is constantly doing the first months, there is a good chance of some of his performances occasionally resembling those that have stimulated him, and the accidental resemblance will be taken by a novice to be purposeful.

Preyer [1] reports that by the end of the fifteenth week he observed a case of imitation in his son Axel. When the father would purse his lips, Axel would do the same. As evidence that it was an imitative act Preyer says it was executed less perfectly than when it was done without any

[1] "The Mind of the Child," Vol. I, p. 283. See, in connection with this, Royce, *Century*, Vol. XLVIII, pp. 137–145.

attempt to reproduce the copy. Now, it seems probable, to say the least, that the imperfectness of Axel's pursing was due to the distraction of the father's presence, rather than to any effect of the child's perception upon his action. If he had really imitated, he should have achieved a more rather than a less perfect expression, for the model must have been an improvement upon the infantile execution. But while there is this doubt regarding the imitative character of the activities of a four-months-old child, there can be no question of the practice of imitation by the seventh or eighth month in the majority of children. Then by the twelfth month the child is repeating many of the activities occurring about him, such as are *not beyond his stage of development.* Up until this period he has lived largely from within, in the sense that he has given expression to his instincts mainly; but now he begins to take account of his environment, and to reflect the social phases thereof. His activities, which were originally unorganized, random, now begin to be arranged into certain systems that reproduce the types presented in his surroundings. But while the child copies, yet his imitations have a certain individuality. He does not hit the mark exactly in his talking, or facial expressions, or performances of any sort. Take, for example, the imitation of reading that comes in due course with most children. The imitator seizes a book when he hears some one reading, and he chatters to himself. He reproduces the simple

fundamental factor, but not the special thing that characterizes this activity and differentiates it from all others.

Apperception in imitation

The child's imitations are just his own individual activities in general features like those of his model. I have made many experiments with children up to the eighth year in causing them to imitate arm and bodily movements of every sort, and linguistic combinations, and it has seemed to me in all cases that they reproduce the general type of thing which they have been accustomed to do, but they overlook the novel particulars. The younger the imitator the more certain is this to be the case. For instance, in moving the arms out horizontally with a wavelike motion, *à la Delsarte*, and back again in the same fashion, the children repeat the fundamental characteristic, but the arms are kept perfectly straight, the wrists rigid, and the fingers tense. Even though I call special attention to the details of the movement, they appear to see and appreciate only what is to some extent familiar to them through their own spontaneous performances. In teaching a few children between five and seven some gymnastic movements, I found that simply performing before them was quite ineffective. I had to actually manipulate their arms and bodies until I got them to execute the movements in question. Repeating this mechanical process a few times, I found I could then get the children to attend to the details of the movements, whereas by simply looking at me they saw the general,

but not the particular characteristics. Their attention picked out only the familiar element in the complex whole, *the thing they had often done.* This principle applies with even greater force to the imitation of speech, writing, and the like.

The principle illustrated in adult imitation.

Even in the case of an adult imitating new activities, the principle here in question may be seen operating. Special coördinations which the imitator has not had his attention drawn to specifically in the effort to *perform* them, he will overlook in his early imitations. He will reproduce, that is to say, the general character of the complex act he observes, but not the individual details which he has not taken special account of. In the game of golf, for example, the coach takes a certain characteristic position before his pupil. He grasps and swings his clubs in a peculiar manner, but the novice does not notice the peculiarities of the "addressing" position, or the particular coördinations in "driving," or "putting," or any of the other strokes. It is probable that the novice really does not see anything but the general upright position in "addressing." The eye reports, "the coach stands erect," and immediately the motor system translates "stands erect" into the habitual erect position of the novice. The eye is not very critical in reporting on novel actions; it regards its mission as fulfilled when it gets data from the models in the environment to reinstate in the imitator his habitual attitudes and postures nearest like those presented in the copy.

If the coach or model be a good teacher, he will not trust to the spontaneous work of the eye; he will *compel* it to take account of special coördinations by coercing attention to them. If these coördinations be quite new, the wise teacher will not depend upon the eye alone, but he will actually manipulate the muscles of his pupil, and so give him the *feeling* of the special adjustments he is trying to establish. The pupil will be made to energize certain muscles and relax others, and the tutor will place his hands, shoulders, and so on, in the desired positions, and mechanically aid the learner in making the right coördinations in giving his stroke. Thus *seeing how to perform* an action depends in large degree upon one's already having had motor experience in performing it. The movement to be imitated must already have been performed spontaneously and have attracted the performer's attention; and then the sense factors comprising the image of the movement become connected with the motor data relating to the execution of the movement, so that when the image is revived it will tend to realize itself in the movement.[1]

The psychology of imitation.

The image of any movement which I am capable of performing may be reinstated by perceiving the movement in another, and then I will act somewhat like that other; that is, I will imitate him. Imitation is thus seen

[1] I simply touch upon the educational bearings of the principle here. The subject is considered in some detail in the next chapter.

to be a more or less mechanical thing in its simplest phases. The child in his spontaneous life is mapping himself out, so to speak. He is acting in all manner of ways in expression of the impulses bequeathed to him by heredity. Many of his actions are in their origin random, or largely so, in the sense that they do not occur for the purpose of attaining certain definite, purposeful ends. But nevertheless they occasionally add to the child's pleasure in some way, and so he is attracted by them and organizes the motor and sense data into a system, so that the sense factors may set off the appropriate movements without any delay. Further, the apprehension of the activity in other people amounts to practically the same in its motor reference as if the image had appeared spontaneously or after reflection in one's own mind.

Whenever the dog barks in the child's presence, or the wind whistles through the cracks, or the kitten purrs or rolls over on the floor, or his brother or sister cries or laughs or runs or does anything else he has consciously done, he will tend to repeat the activity. This tendency decreases with age, for as the years pass one's activities get ever more completely established in definite channels. His modes of reaction, in all this implies, become fixed, so that one adopts new modes with ever increasing difficulty. A sort of drainage system for the energies of the organism comes gradually to be established, and this renders it increasingly difficult to get a supply of energy for the sup-

port of new activities. Images of movements not within the circle of habitual ones receive less and less attention as one approaches maturity; and in time they make little or no impression upon the system of images that have gained the right of way. In popular language, a man's "character" means just the sum of these settled modes of action which are practically unalterable. They resist all change; the man moves about among his fellows, but their personalities rarely find their way into his springs of conduct. Ordinarily a man who has lived under fairly uniform conditions behaves at forty-five much as he did at twenty-five; his individuality has preserved itself from effacement by the other selves he has touched for twenty years.

The course of development with respect to imitativeness.

But things are different with the child. He has the equipment needed for action, but for the most part he has no definite mode of using it, so he patterns after any copy that is presented to him. He is plastic, as we say, or impressionable with reference to the personalities that he comes in contact with. Of course, the young child does not reproduce all the expressions of the personalities he encounters. He takes the very simplest things at the outset — pursing the lips as a type; then those a little more involved, bo-peep and simple gestures and facial expressions, and vocalizations and postures, for example. Then later he copies more complex acts involved in the accomplishment of relatively simple tasks of some kind,

as carpentry or farming or baking or nursing, and so on. As he grows facile in these direct and very concrete activities he responds to ever more complicated ones in which the mental factors become more important, and the motor factors are less in evidence; he plays at school, for instance, or preaching, or society formalities. He comes, last of all, in his high school or college period, to imitate the social, political, religious, and what may be called the scientific activities going on in his environment, or in the books he reads. In this last period there may still be some remains of his earlier responses; he may copy the modes of speech and the manners of his comrades, but this is not as prominent as in his early days, and the things he copies are more subtle, less conspicuous things which as a child he would have missed.[1] The line of march is ever from the relatively simple and elementary to the more involved and complex.

TOPICS FOR INVESTIGATION AND DISCUSSION

1. If you have ever studied French, or any foreign language, or if you have ever heard people speaking in a strange tongue,

[1] Mr. Russell's collection of imitations ("Child Observations: Imitation and Allied Activities") shows in an interesting way the gradual ascent of the child from a stage of copying very direct and simple acts through stages of constantly increasing complexity. He cites over a thousand cases of imitation classified according to the ages of the imitators, ranging from one year to fifteen years. See also Frear, *Ped. Sem.*, Vol. IV, pp. 382–386.

say whether you were able to reproduce precisely what was spoken to you. If you could not, say just why.

2. Why does an Irishman, or other foreigner, who comes to this country after he is mature always retain a brogue? Do you think such a person actually *hears* our words exactly as we do? Why? Why does a German who has learned to write English script after he has become mature always show traces of the German script in his English forms?

3. Can you pitch a curved ball? Have you ever watched an expert do it? Did you see every detail of his movements in pitching the ball?

4. Why is it so unusual for a novice to follow exactly his gymnastic teacher in the execution of simple exercises?

5. Why cannot a child of six, say, who has a very wide range of vocal power, run a scale the first time he tries in imitation of his teacher?

6. Are children more or less imitative than adults? Why? Are children of five more or less imitative than children of ten? of fifteen?

7. Observe the children about you with respect to their imitative activities, and see if you can make a list of the activities most commonly and persistently imitated at different ages from five onward.

8. Why does not a normal child of ten, say, continue to imitate the same activities all his life? Why does an idiot do so?

9. Why does a child of five not imitate all that is going on about him? Discuss the same question with reference to adults in different vocations and different social environments.

10. Does imitation assist the individual in adapting himself to the world? Is it ever a handicap to him? Will the child who imitates most readily have an advantage in adaptation?

CHAPTER VIII

THE TEACHING OF SCHOOL-ROOM ARTS

The scribble stage in acquiring school-room arts.

IF now we glance at the way in which the child acquires such an art as drawing or writing, we shall see that he proceeds in the same manner as he does in mastering any other voluntary or imitative act. There is in the beginning a period of more or less random movements. The muscles seem to run their own course without much control from the image to be reproduced. If the child of four has definite visual images of the forms to be executed (and the probability is that he lacks such images), they have at any rate not yet gained mastery over the motor apparatus employed in their reproduction. Without doubt he is governed to a slight extent by his observations of what those about him do with pens and pencils, but he has appreciated only the most general characteristic of these activities — simply *making lines.* He has missed most of what pertains to the making of *particular kinds of lines as elements of particular form-complexes.*

This is the scribble stage in writing or drawing, to use Mr. Clark's term,[1] a stage which has been observed by

[1] See his "The Child's Attitude toward Perspective Problems"; "Studies in Education" (Barnes), Vol. I, p. 283.

Barnes,[1] Cooke,[2] Sully,[3] Lukens,[4] Baldwin,[5] Shinn,[6] Burk,[7] and others.[8] This stage in the mastery of these arts resembles in a way the first period of the child's motor life when most of his movements are expressed at random, when his activities occur without direct reference to the needs of correlation with the world without. "By the fifth year, though, the child is commencing to bring his motor processes into proper relation with the images to be reproduced. His drawings now show that his hand and his eye are taking some account of one another; that is to say, he is beginning to acquire the power of *deliberately* reproducing a copy. Before this time, according to my observation, a child will not attend in any thoroughgoing way to a copy in writing. He glances at it for a fraction of a second only, just long enough to get the suggestion *lines*. He pays little if any heed to the direction or spatial relations of these lines; indeed, it is probable he is not aware that any definite and invariable relations of this sort exist.

1 "Studies in Education," Vol. I, pp. 283–294, Vol. II, pp. 75–77, 163–179.

2 "The ABC of Drawing," Rept. Educ. Dept. Gt. Brit., 1897, pp. 115–156.

3 "Studies of Childhood," Chap. X.

4 "A Study of Children's Drawings," Vol. IV, pp. 79–110.

5 "Mental Development, Methods and Processes," Chap. V.

6 Univ. of Cal. Studies (edited by Brown), 1897.

7 *Ped. Sem.*, Vol. IX, pp. 296–323.

8 See an article by O'Shea, N. E. A., 1894, pp. 1015–1023; and also Chamberlain, "The Child: a Study in the Evolution of Man," Chap. VI.

How does the child become copy-minded?

This last point should be worked out in a little greater detail. I write the letter *m*, for instance, upon a blackboard and ask a child who has had no experience to reproduce it. In response his pencil runs here and there over the paper before him. His attention is apparently not concerned at all with the copy, but only with the lines which he is making. It is evident from his expression that making lines affords him pleasure; but marks of any sort will please him. He seems to be quite indifferent to the likeness which exists between his reproduction and the copy; the latter really gets no hearing at all. It would, I think, be within reason to say that the young child is not copy-minded to any extent; he is only *muscular-minded.* Again, and without giving him any instruction in the meantime, I ask him some time later, say at five years, to reproduce this same copy. His first stroke now resembles the first part of the letter, but the rest is chaotic. He pays slight attention to the copy, and none whatever after the first stroke is made. The copy exercises very little control as yet over the motor processes. It is perhaps worth remarking that I have often observed a tendency in children in the later stages of this random period to represent in a crude fashion forms, as a flag, for example, made familiar to them from experiences in their play life. I ask a four-year-old to copy a letter from the board, and he will show me a picture that he calls a flag, and that has a slight resemblance

thereto, perhaps. Evidently letter-form and flag-form are about the same thing to the novice. Different forms do not yet have distinct individuality, so to say.

It is important to note here, however, that when at this age V. or H. *saw me make a letter* he would make something of the same general character. They would reproduce the *movement of my hand* in a general way. Their attention was always centered on what I *did*, not on what I *made*. If they do not look at me while I am making it, they seem to get no sort of idea of the elements of the copies. They can perceive and appreciate the elements in a more or less complex movement, but not so with a form the making of which they do not observe. They have not had any significant experience with this sort of thing in its elements; it has not entered vitally into their daily lives. They have not had occasion to become vitally acquainted with it or anything like it, *in its elements*.

Now, in learning to make the letter *m* (which is typical of all writing and drawing) it has been said that the first kind of data which is of service to the learner is gained from observing *the thing being done;* and he tends to imitate the movement when next his eye follows the lines as they are made. In this way he becomes conscious in some measure of the elements of the complex form. Without such optical tracing, which brings the different parts of the form on to the retina in orderly succession, the

letter must remain simply a confused, indefinite, obscure whole. Of course, the motor series established in following the movements of the hand and tracing the lines as they are made, together with at least partial reinstatement through imitation of the hand movements as they have been observed,[1] all contribute to *define* the original confused whole, to bring its elements to the front, and in the way in which they are related in the original. Then there are the *retinal* data, the image of the form. Finally there are the kinæsthetic data, derived from muscular coördinations involved in actually tracing the letter. Thus we have four sorts of data concerning the individuality of this special thing, and these must get related to one another in such a way that the appropriate motor processes will be uniformly set off when the visual image is reinstated. When it is recalled that at the outset the apprehension of form of this character is extremely indefinite, and the muscles have the right of way, it can be appreciated that there must occur quite a struggle before the motor processes will become wholly subjugated and obedient to a clear, well-defined image.

But the natural history of this process is not essentially different from other adaptive and imitative processes we

[1] Baldwin and other writers take no account of what I have called the imitation data in the process of learning these movements, but they certainly are important. They may be said, perhaps, to constitute a sort of apperceptive basis for the interpretation of this new complex.

have studied. The learner must pass along the route which he pursued in learning to reproduce the language, for instance, which he heard spoken about him in his early years. There must be excess action, some of which will hit the mark, and the successful attempts will be noted, for they will give pleasure. V. at four years is delighted when he makes anything resembling a copy which is set him. Whenever children discover any likeness between their scribblings and the things about them they run in high glee to communicate the fact to the parent or teacher, indicating that the "hits" make a deep impression, and the learner is encouraged to "try, try again," with the result that the right movements become ever more deeply established, and the irrelevant actions grow less and less conspicuous from disuse. Then the learner is constantly brought into relation with the forms he is trying to reproduce in ways which help him in his learning. He sees his sister making them, or his teacher takes his hand and helps him to execute them, and these experiences assist in establishing a visual-motor process corresponding to the given letter. And the natural history of learning any form is the same in principle.

The principle in writing is the same as in any adaptive activity.

It may be well to call attention to the fact that in his spontaneous activities the child is gaining experiences which aid him in the apprehension and reproduction of graphic forms such as we find in drawing and writing. For example, he traces lines with his finger on the window-

pane in cold weather. He traces figures with his fingers in the sand-pile. His mother in showing him pictures aids him in noting elements by *taking his finger* and *tracing them out*. In these and in other ways he gets images of forms and the movements required to create them coupled together. By the time he has reached the age of five graphic form has become in a measure a part of his environment, and he has significant experiences with it, and this gets him into the way of attending to it, and striving of his own accord to reproduce it. He sees only general tendencies, which is shown readily enough when at six or so he tries to reproduce the copies in his copy book. He apprehends the main characteristics of the forms, but such matters as precise spatial relations, the degree of curvature of lines, relative heights, terminations, and the like he misses very largely.

It is probable that the learner early settles into certain modes of reproducing his copies which, while quite imperfect, yet satisfy him. They appear like the copies to his eyes. It is a simple enough fact that each child has his own peculiar handwriting, and I have seen half a dozen children from eight to ten years of age while looking at the same copy reproduce it each in his own way, and feeling he had hit the mark. The copy simply reinstated the motor habits associated therewith; and each individual *saw* largely in terms of what he had *done*. Form is mainly a *motor* thing, so to speak; the retina alone gives but

signs which must be filled out from motor experience. What the child has not traced he does not see in any detail; and what he has traced he sees about as he has executed it. We see forms very largely through our motor habits, that is to say, though I am aware this will sound queer to many.

The principle here in question holds for other senses and processes as well as for vision and form. To illustrate, H. in her fourth year had formed the habit of saying "effilant" for "elephant." I would pronounce the word properly to her, but she would come back with the incorrect form, although she imagined she was right every time. Instances like this will be recalled by any one familiar with children. An auditory stimulus will always tend to reproduce itself in the accustomed fashion; and once it is reproduced it is difficult to keep it before the attention in order to analyze it into its elements. The function of attention in its lower forms is to establish connections between a stimulus and its appropriate reaction, and the former is of account only for the latter. Often the general characteristics of a situation will be enough to set off a certain response which works well enough, and so we do not bother about details. What H. hears in "elephant" is a few prominent sounds, and she has not listened critically to see just in what sequence they occur. The auditory stimulus is received as a unit and the motor process is set off as a unit, so that elements get neglected.

The principle seen in a child's correcting wrong habits

And the habit cannot be corrected until the attention is turned toward the elements, and the onrush of the stimulus (the sound of the word) into the usual vocal execution is checked. In getting H. to pronounce "elephant" correctly, I led her first to break up in her attention the auditory whole into its prominent elements by sounding each part separately for her and comparing it with words with which she was familiar and was able to pronounce correctly, she meanwhile copying me. In this way the attention singled out the main parts and these were already connected with appropriate motor processes, as in *el-e-vator* and *el-e-ment,* so that as soon as I got the first two syllables established in their right relation in her attention, then I could easily carry them over to the last part of the word, *phant.* By repetition she succeeded in establishing a new habit, though the old one hung on for some time; and it was only by my frequently drawing her attention to the correct form in the way I have indicated that she finally mastered the word.

One who has taught children the art of writing realizes that the process of making their imperfect reproductions more like their copies consists principally in directing their attention upon detailed characteristics which they have overlooked altogether; and this is done not merely by commanding them to look closely, but more especially by giving them actual motor experience which

will define what the eye reports only in a very general way. The wise teacher will trace the copy for the novice so that he can attend to the movement of her hand. Then she will, if necessary, actually take his hand and give him the feeling of how the thing is done. She will have him work rapidly, so that the elementary motor processes may be organized into one whole. Then if she can get the series repeated frequently enough, she will succeed in her task of so connecting images and their motor execution that whenever the former are reinstated they will be automatically reproduced. She will not weary the pupil by talking to him about "noticing carefully," "paying attention," and so on, if he is just beginning, for he really has little in his experience which will enable him to attend effectively, and such experience as he has may lead him astray. Do everything you can to aid the learner in gaining just the right motor experience; this is the whole of the law and the gospel.[1]

TOPICS FOR INVESTIGATION AND DISCUSSION

1. During your school course did you change from slant to vertical writing? Do you know of any one who has had this

[1] I have, of course, considered only one phase of imitative activity. For a treatment of the subject in a more general way, as it is related to education, see Deahl, "Imitation in Education," Columbia Univ. Cont. to Phil. and Education, 1900; and Harris, Add. and Proc. N. E. A., 1894, pp. 637-641.

experience? How long did it take to complete the change? Why could not the change be made instantly?

2. Is the extremely illegible penmanship of a five-year-old due to lack of muscular power, or to some other cause?

3. Can an individual, a novice, say, see forms much more accurately than he can reproduce them? Or is imperfect drawing due mainly to inadequate and imperfect seeing?

4. If possible make a test with a young child who has had no experience in writing by placing a copy on his paper or on the blackboard, and noting how fully he perceives all the form characteristics of the copy. Note whether he really gives attention to the forms as such, and see if you can explain what you observe.

5. If you are not an artist, could you reproduce a drawing better if you observed it being made than if it were set before you completed? What is the principle involved?

6. Have you observed that pupils sometimes reach a point beyond which they do not progress in making their writing like the copy, for they feel that they reproduce the model quite accurately? Explain this phenomenon.

7. Comment upon the following: A pupil in the primary grade is not writing well. The teacher puts a copy on the board, and asks him to reproduce it. Upon his failure to do so satisfactorily she upbraids him, says he is careless, and she commands him to give better attention. As a punishment she keeps him after school, and requires him to practice his writing by looking at the copy and trying to imitate it.

8. Say whether you can see more of any novel activity than you are able to reproduce. Give specific instances illustrating the principle.

9. What is the most efficient method of getting pupils to

see just what you wish them to in physical exercises, and to hear as you wish them to hear in articulation?

10. Is it best to require pupils to observe a copy *as they try to reproduce it*, or to study it first, and then reproduce from memory? Should a pupil get into the habit of reproducing rapidly or slowly?

CHAPTER IX

DEVELOPMENT OF COÖRDINATED ACTIVITIES

The inco-ordinated condition of the infant.

DOUBTLESS every one realizes that when the child sets foot on these shores he is equipped with an elaborate outfit of instruments for the performance of delicate tasks, but he seems not to have learned how to use them to advantage. "He has two eyes for to see with," as the nursery rhyme runs, but he cannot make them pull together. Each pursues its own course quite regardless of its mate. "He has two hands for to work with," but at the outset he seems little the better for his possession. So he appears among us provided with an apparatus for standing erect and looking nature in the face, but yet he is compelled to lie flat on his back for many weeks; and it is many months before he comes into his human birthright in respect of bipedal locomotion. With all his equipment he is just a helpless creature, mewling in his nurse's arms.

In one way he is far lower in his estate at birth than the colt or calf or kitten or even the chick, for they can handle themselves fairly well from the beginning. The puppy or lamb no more than touch the earth before they try their legs, and they find them not wholly useless. In a

week or so they are running races with their elders, and practicing all the arts of their kind with considerable skill. But how slowly in comparison the child becomes master of his bodily members! By the end of his first year we can see he has made progress, but after all he has not yet gone far along the route toward well-controlled, efficient adulthood. Even after three or four or five years have passed he is still a novice in the employment of a considerable part of his equipment. We forbid him the use of all sharp implements because he cannot coordinate his muscles so as to manipulate them with safety, though he may wish earnestly so to do. We will not let him handle our fragile china, or costly books, or valuable objects of any sort for the reason, again, that he has not acquired such precise control of his appendages, so to speak, that he can do exactly what he needs to with them in dealing with many of the objects in his environment.

Common-sense philosophers (by whom I mean the ordinary persons of good general sense but without special knowledge or training) maintain that the reason of the infant's incapacity in the performance of complicated tasks is because he is not *strong enough* in a physical sense; his muscles are not sufficiently developed. Or perhaps he has not learned how to "use his will." These people overlook the fact that the child can support his weight, hanging by his arms, for some seconds at the moment of birth; and he has a good bit of muscle in his

legs too, as one can ascertain by attempting to straighten them out from the constrained position in which they are so generally kept during the first days of post-natal life. He has more gross muscle, so far as that goes, than he would require to support his weight, but he has not learned the art of using it in maintaining himself in equilibrium in an erect position. It is a question after all of *method of use* not of *crude* strength. Again, these philosophers overlook in their naïve way the perplexing problem of why the child should have to learn to use his will, and how the learning proceeds. Is it a product of experience, of education? Or is it that the infant possesses volition, but it is not yet correlated with the environing world? These questions common-sense philosophy passes over in silence.

There are, of course, a few coördinated movements of which the infant is master from the beginning. He is, for instance, an adept in the execution of certain movements required to secure his food. Put your finger in the mouth of an infant, and note how complex and perfectly definite are the coördinations of tongue, lips, and jaw involved in sucking. Again, the child at birth has a measure of control over his vocal apparatus, enough at any rate so that he can produce simple vowel sounds. He has, too, become possessed in some way of the ability to manage his arms to the extent that he can extend and contract them; and he can grasp an object placed under

his fingers and convey it with considerable accuracy to the centre of being at this time, the mouth. Mr. Burk thinks this performance is at first a mere accident, while Preyer, Miss Shinn, and others regard it as a quite definitely fixed coördination. Given a stimulus in the palm of the hand and the fingers will generally close reflexly in the grasping movement. All observers have noted this fact; and judging from what I have myself seen, the fist will, without fail, travel mouthwards. I should say that the activities of the arms are in considerable part spasmodic at first, though they tend, in the case of palm stimulation, in the direction of the desired port, and after more or less of awkward fumbling the fist usually gets into the mouth. When the hand comes in contact with the skin anywhere in the neighborhood of the mouth, reflex movements are set agoing all over this region, and these have for their aim to bring the thing into the mouth. With these several factors collaborating to attain the same end, success is finally achieved.

Inherited coördinations

So there are a few other relatively simple coördinations of which the infant is capable at the start, but the inventory of the entire list is easily made. Practically the whole business of becoming coördinated in adjustment to a complex environment lies before the individual. In the beginning most of his energy seems to be expended in keeping the muscles of his arms and hands and legs constrained, and in moving them back and forth in the

same plane. The fingers are clenched most of the time, even during sleep. Mr. Trettien's correspondents [1] appear to have all observed the tension of arm and fingers in the infant, in proof of which note what they say: —

M. (male), 3 wks. His fingers were clenched both when awake and asleep.

M., 2 wks. When awake his fingers were bent, but when asleep his fingers were clenched.

M., 5 mos. The fingers were bent and in constant motion when awake and asleep.

F. (female), 2½ mos. Kept her hands closed when awake and open when asleep.

M., 2 wks. The fingers were clenched when awake, but clenched tighter when asleep.

M., 4 wks. During the early weeks of life the fingers are clenched when awake and bent when asleep.

M., 4 wks. The fingers are clenched so tightly that the nurse must pry them open in order to wash the palm.

F., 4 wks. She would always keep her elbow bent and would seldom attempt to hold the arm straight.

M., 2 wks. The wrists are but slightly bent; the elbow is considerably bent.

M., 3 mos. The wrists and elbows are bent.

These testimonies corroborate statements made by Sigismund,[2] Preyer,[3] Miss Shinn,[4] Mrs. Moore,[5] Mrs. Hall,[6]

[1] See his "Creeping and Walking," *Am. Journ. of Psych.*, Vol. XII, October, 1900. Also Reprint, p. 16.

[2] "Kind und Welt, Die fünf ersten Perioden des Kindesalters."

[3] *Op. cit.*, Part I, "The Senses and Will," pp. 187–282 (New York, 1888).

[4] *Op. cit.*

[5] *Op. cit.*

[6] "First Five Hundred Days of a Child's Life," *Child Study Monthly*, Vol. II, pp. 330 *et seq.*, 394 *et seq.*, 458 *et seq.*, 522 *et seq.*, 586 *et seq.*, and 650 *et seq.*

Central or fundamental movements predominate in the beginning.

and other students of childhood. There is little amplitude, little variety, and but slight complexity in these first movements. They are mainly fundamental, in the sense that the biceps, for example, in the manual series, are vigorously energized, but the very tips of the fingers cannot be employed with any success in fine coördinations. The fingers can be manipulated after a fashion, but they are "clumsy." Mr. Burk has called attention to the manner in which an infant will grasp a pencil, for instance, or a saucer. If you observe him doing this you will appreciate that his will has not yet gained control to any extent of the ends of his fingers, in the sense that they can be utilized in the execution of intricate tasks. The infant appears to have about as good use of his toes as he does of his fingers, and this is worthy of remark since, as Mr. Trettien has pointed out, the skill in managing the toes is lost in part as development proceeds, while finger-skill constantly increases. Again, though the infant can respire perfectly, still he has slight management of his lips, tongue, teeth, and palate in the modification of the expired air so as to produce consonantal sounds; and he cannot even control the vocal chords so as to produce most of the vowel sounds of which he will be capable later.

Now let us follow the child a little distance, and observe how he acquires manual dexterity, which implies the ability to manipulate with precision any segment of the

The first stages in acquiring manual dexterity.

manual system in coördination with any other segment, or with the arm, or any part of the organism, or any external object.[1] The first sign of advance is seen in what may be regarded as a sort of breaking up of the original biceptual tension. The biceps seem now not to be stimulated so vigorously and constantly as formerly. Some observers have attempted to be precise in days and hours when changes of this sort occur, but this appears to be a quite impossible task, since these really have no absolute beginning. They are phases of a continuous process of evolution, of refinement, of differentiation, of developing complexity. They do not present themselves suddenly as something quite novel which can be rigidly discriminated from what has gone before.[2]

Then progress along any line is probably made with unequal rates of speed by different children. In the development of arm, hand, and finger skill, H. showed

[1] Space will not permit me to go into the neurology of coördination. Any reader who is interested in the neurological side should read Flechsig, "Gehirn und Seele"; Donaldson, "The Growth of the Brain"; Burk, "From Fundamental to Accessory," etc., *Ped. Sem.*, Vol. VI, and Reprint; Mercier, "The Nervous System and the Mind," Chaps. III–VI; Hoffman, "Psychology and the Common Life," Chaps. I, III; Broadbent, "Hughlings Jackson," *Brain*, autumn, 1903; Ross, "Diseases of the Nervous System."

[2] Of course, this principle in its broadest statement applies to every phase of mental development. Nature does not work *per saltum* in the development of any power. I cannot agree with those observers who declare they have noted very marked and sudden transformations at different periods in mental development.

considerable progress by the seventh week. She was at this time operating the whole-arm system during most of her waking hours; but the original rigidity was less apparent, the fingers were opening and closing constantly, and the thumb began to play its part in the game. Until about this period, the thumb had not reported for duty; it kept itself hidden most of the time in the palm of the hand, a phenomenon which Dr. Mumford[1] and others have commented upon. Now, M. crept along much more slowly than H. When she reached her seventh week she had not got a great distance from the starting point. S., a boy, appeared to be at least a week or two behind his sister H., and V. was later still. Of course, lacking the means of exact measurement it is impossible to determine rates of progress with absolute precision, and no attempt should be made to do so. The accompanying figure (1) illustrates the point here in question. Four observers find that their subjects begin various familiar activities and abandon them at different ages; but it should be noted that they all take up the activities sooner or later, and in about the same sequential order.

The wave of development is toward the extremities.

But we must not lose sight of our child developing manual dexterity. As he runs on we see him gaining ever greater flexibility and efficiency of hand and fingers, and greater amplitude in the employment of the arm as a whole. There is a gradual decrease in the predominance

[1] See *Brain*, Vol. XX, p. 302.

of the biceps, and increasing action in forearm, wrist, and fingers. The wave of development moves constantly outward, — toward the extremities. This does not im-

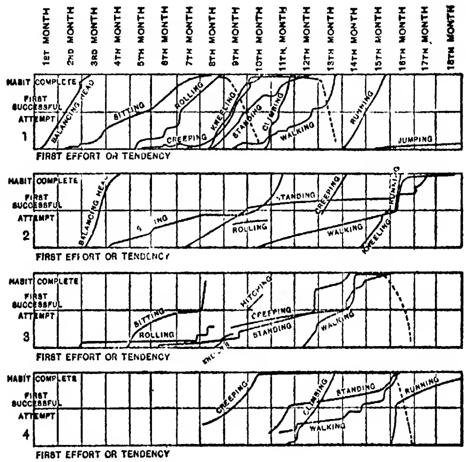

FIG. 1. — 1, Miss Shinn's record; 2, Prof. Preyer's; 3, Mrs. Hall's; 4, Mrs. Beatty's.

The dotted lines indicate the decline and disappearance of the movement.

The broken lines show that the record was incomplete. In a few cases, however (as "rolling" in Prof. Preyer's record), the movement itself was but partly developed by the child. (From Miss Shinn's "The Development of a Child," p. 411.)

ply, of course, that there is not continuous development all along the line; it means simply that at the start the most accessory members, to use Ross's term, function the least effectively, considering what they are designed to

accomplish, and so development has the most to accomplish in the outlying regions. What progress in this respect has the child made by the sixth month? Preyer reports that his son Axel showed much deftness before his seventh month in picking up shreds of paper from the floor; but the term "much deftness" is quite indefinite. Bits of paper may be taken between the thumb and fingers without very precise and varied control of the outermost segments of the manual apparatus. As a rule, I think, children of this age are grasping at everything they see; they have become "little grippers" as Sigismund called them. They pick up smallish objects wherever they find them, but their essays really seem very crude and ineffectual when measured by the adult standard, which is the only just basis of comparison. It does not serve our purpose here to compare the child's present skill with his condition at the very beginning; nor should we accept the evidence of the mother who marvels that her child should be able to seize hold of anything. Her wonder and admiration are likely to lead her to believe that he executes his tasks with as much delicacy and deftness as she does herself.

The child of six months or a year, or even two or five years, is long in gross muscle and short in delicate coördinations. He puts more actual force into such a task as writing, for example, than an adult does. One may see this principle illustrated in the tension of muscles that

should remain at rest when the child applies himself to delicate tasks. In all his hand activities in the early years the characteristic which impresses one most markedly is the amount of force which is expended upon them. Delicacy of adjustment is quite generally lacking. It seems that the novice in order to perform complicated tasks, requiring mainly activities of accessory muscles, has to expend a comparatively great amount of energy so that it will overflow old channels deeply grooved from long use, and some of it will escape into new and as yet shallow ones. The caresses of a year-old child, which he intends doubtless to be gentle, are often annoying because of their vigor. When he is attempting acts that should be done tenderly, as touching his father's eyes in play, he jabs into them as though he had no control over his biceps. Most mothers who have tender babies in a house where there are vigorous five-year-old boys have occasion to learn that the latter tend always to express their kindly feelings most energetically and crudely.

As the months pass we may note that coördination increases, and muscularity, so to say, decreases. If you try a child of two years at threading a needle with a moderate-sized eye, you will notice extreme tension at once in the fingers, and soon in the face, and elsewhere in the body, and rarely if ever can he succeed in his task. Scissors are used very badly at this period, and writing with an ordinary pencil causes excessive tensions. In the use of

his knife and fork and spoon at table the undue prominence of the biceps is noticeable. It is not a deficiency in brute strength that makes the child incapable; he is simply unable to use properly what he possesses in the management of a complex mechanism. His force is not rightly distributed and correlated throughout the parts of the whole apparatus employed. The part nearest the power house gets too much force, and this throws the rest of the machinery out of gear, considering the special work to be done.

Force rather than delicate or precise manipulation.

A child of three or four or five years endeavoring to use tools illustrates the principle of development under consideration. S. at three can put a good deal of force into his experiments with a hammer, but he cannot hit a nail on the head once in ten trials. He must be watched by his elders when he is pounding to see that he does not bruise his fingers. V. at five has much greater precision, though compared with H. at eight he is still crude and clumsy; so much so, indeed, that the older one often makes merry at his expense, and he in turn rallies his younger brother. I sometimes let S. wind my watch, and he puts a great deal more force into the business than is required.[1] When S. tries to imitate H. in her painting lessons he apparently thinks the thing to do is to put all the muscle he can into the manipulation of the brush; he

[1] See, in this connection, Hancock, "A Preliminary Study of Motor Ability," *Ped. Sem.*, Vol. III, pp. 9–29.

is a dauber, not an artist yet. H. shows considerable delicacy in her use of the brush, but still her work very patently lacks the fine touch which is made possible through the more perfect coördinations of her teacher. When H. attempts to do very fine work one result is seen in marked tension of fingers, and constraint of muscles in the face and the whole body. H.'s teacher, though, handles the brush for long periods every day with great ease and apparently with little fatigue.

Bryan's studies upon the development of precision[1] reveal the principle, which doubtless most of us have appreciated in a way, that throughout the maturing process there is continual improvement, except for an apparent temporary arrest at puberty, in the ability to control the motor mechanism, in its accessory as well as fundamental functions, so that tasks requiring exact control and precision can be performed more and more satisfactorily as the years go on. Dr. Gilbert has reached some suggestive results in his experiments upon the accuracy of kinæsthetic sensations with increasing age, which show the general principle in operation.[2]

The development of pedal dexterity. What has been said regarding the development of coordination in the upper limbs applies in principle to the development of the lower limbs. At the start the legs

[1] See his "On the Development of Voluntary Motor Ability," pp. 53–62.

[2] See Burk, *op. cit.*, Reprint, p. 57.

are kept in a tense position with the soleus muscles generally energized. The movements are automatic, and in a plane up and down, as Perez [1] and others have observed; but development progresses outward here as it does in the arm and hand. The over-action of fundamental muscles in the early weeks produces constraint, and this seems to be characteristic of the infant among primitive men as among us. One may see civilized mothers who are troubled by the cramped position of the limbs of their children, and they endeavor forcibly to stretch them. Primitive mothers try the same thing. "Certain Armenian people, after the fifteenth day of an infant's birth, thoroughly stretch the shoulders daily, pull out the legs and arms, press each muscle and joint, raise the head and stretch the neck to give it its proper length, or the child is suspended by its feet and allowed to swing back and forth several times like a pendulum, then it is turned about end for end and the process repeated. The Russians press every muscle and member of the body at birth. . . . Even the Germans had an early custom which is practiced in some sections of the country to-day, where the pressing and stretching process was employed to beautify the body." [2]

I have been much interested in observing children in

[1] "The First Three Years of Childhood," translated by Christy, 1885, p. 14. See also Trettien, *op. cit.*

[2] Trettien, *op. cit.*, p. 20.

their first essays at walking. They use their legs as if they were jointless; they might almost as well be wooden. There is little if any flexion or coördination of the different sections with one another. Rigidity is the word that describes these early movements. It appears impossible for the child to energize both fundamental and accessory muscles in sequence as they are required in order to execute the complex act of walking in the most economical and effective manner. This phenomenon is seen again when the kicking act is undertaken. At first the toe is the end of a pole; the limb is swung as an unsegmented whole, and in this way the toe is brought in contact with the object. But the will does not concentrate on the toe, and make it the leading point for the expression of energy, all other parts of the mechanism serving only to advance the projecting point. One might think of the will as not having progressed much beyond the thigh in the beginning of the act of kicking, and the business of development is to carry the will out to the extremities, so that they can be manipulated in accord with the central segments in the execution of any act. S. at fifteen months in trying to imitate the climbing movements of the older children did not seem to energize the foot at all to help himself up as the child of four does. He pressed his knees against the post, and the foot was not brought into requisition. V., though, at three and one-half, makes the foot the objective point of his attention; it is turned in

against the tree, and he employs it principally in raising himself.

The development of coördination in speech.

If now we trace the development of coördination in speech, we shall find the same general plan pursued. The infant's first speech, or wail perhaps, contains but a note or two, as *ă* or possibly *ăü*, with which every one must be familiar. These notes can be produced with comparatively slight coördination of the vocal apparatus. The cords must be tightened up a bit and the expired air directed upon them; but the infant cannot modify the current of sound thus produced, nor can he even modify the pitch or quality of the current itself. His repertoire is limited to the simple vowel range. But by the time he has attained his fifth month, to be safe, he has made some progress toward extending his range of vowel production. There is beginning to appear also certain consonantal sounds, those made by the lips acting on the current of sound. Most observers have found that the consonants denoted by *m*, *p*, *b*, and *d* are the earliest to be executed, and my own observations indorse this; though in the very beginning even these consonants are not produced in a clear-cut, distinct way.

Then when the child begins to imitate the language he hears about him he reproduces the simplest sounds first, those easiest made, and, speaking generally, he comes last of all to those combinations that demand the most difficult coördinations. A long combination requir-

ing for its execution the skillful manipulation of the vocal apparatus will either be left until very late, or it will be mutilated, often beyond recognition. The simplest element in it will be picked out and reproduced; or easy combinations will be substituted for the difficult ones. Thus, speaking in view of my own observations, *what* will be reproduced as *hä; here*, as *hē; nail*, as *nā; this*, as *dĭt; there*, as *dā; that*, as *dăt;* and so on. For *where is that?* the child says *jā dăt?* for *noise*, he says *noi;* for *Harriet*, he says *Häwi*. The young child does not say *Hăwi*, but *Häwi;* and any one by testing it may see that the combination of *ă* after *h* and before *w* is more difficult than the *ä* in the same position. This is the type of very much that is found in children's use of words. The principle is seen again in the pronunciation of a word like *some*. The child makes it *shûm*. The motor process required to produce *sh* before *u* is really fundamental as compared with that required to reproduce *s* in *some*. So again *horse* becomes *horshie*, apple becomes *appŭ*, *get* becomes *geh*, *farther* becomes *fädy*, *basket* becomes *baky*, *university* becomes *ūvŭty*, and so on *ad libitum*.

In the beginning the child universally, I think, omits *ll*'s on the end of words, as when *ball* is made *bäbä*, *tell* becomes *teh*, *fall*, *fä*, and the like. Again, the sound denoted by *r* is very frequently omitted, as when *broken* becomes *bōken*, *rock* becomes *ok*, *for* becomes *fah*, etc. *Th* is quite universally omitted from words like *that* and

this. *Ng* is always omitted. When the following combinations are followed by other sounds, they are almost universally omitted or something put in their place, — *st*, *ck*, *nd*, *rd*, *sk*, *ok*, *ru*, *ough*, *fe*, *ft*, *fr*, *th*, *ve*, *nk*, *ght*, *fl*, and others of this character. Again, certain sounds are omitted when they occur in combinations at the beginning or the end of a word which makes their production difficult. Tracy has summarized the results of many observations, and his tables derived from an examination of seven hundred instances of mispronunciations show the general principle at work.[1]

The principle illustrated in the child's use of sentences.

The principle of development here in question is further illustrated when the child has learned the use of some words and has begun to construct sentences. If several words apply to different objects that have some common resemblance, he will choose the easiest word for them all.[2] For instance, he says "*suppy*" for *breakfast*, *dinner*, and *supper*. Again, he will omit words that will make his coördinations more intricate. "*Mamma, fā go?*" means "Mamma, where are you going?" and these instances are typical of much of the child's linguistic activity during the first three or four years. Of course, children differ

[1] See his "Psychology of Childhood," pp. 148–157.

[2] It is understood, of course, that I am not here attempting to discuss the psychology of language. This will require a volume in itself. I have already published one chapter in that volume, — "The Parts of Speech in Early Linguistic Activity"; Proceedings of the Wisconsin Academy of Arts and Sciences, 1905, and separate monograph.

greatly in the rapidity with which these coördinations are attained, but they must all pass along the same route, though at different rates of speed. S. was as far along in the mastery of language difficulties at twenty-one months as V. or M. were at three and one-half years, but he seemed not to skip any of the stages; he simply ran the race faster.

Preyer's observations on speech development.

By way of summary of the points relating to the development of coördination in respect of speech, I may add a diagram showing the results of Preyer's observations upon his son. It shows the line of progress not only in the production of sounds, but also in the use of the sentence, and in the hearing and understanding of words; and while we are here concerned primarily with the development of motor coördination, still there will be no harm in seeing the general principle observed in other phases of development. The movement along every line is toward greater and greater power of coördination. Preyer's technical terms, many of which are derived from pathology, all denote degrees of incapacity in linguistic execution, and reception and understanding. For instance, after the period of reflex and automatic sounds, and mere babbling, when the child really attempts to reproduce the words he hears, he enters the stage of *dyslalia*, when he cannot make all the sounds employed in the language used about him. Then as he moves on he passes through the stage of *paralalia*, where speech is still difficult, but the

defects so prominent in the former stage are being overcome. When he attains his third year he has mastered most of the elementary sounds, and can use them in combination, but not readily or very easily. He suffers from *bradylalia* or slow speech, due to his difficulty in articulation, but he is gaining ground. In time he gains enough

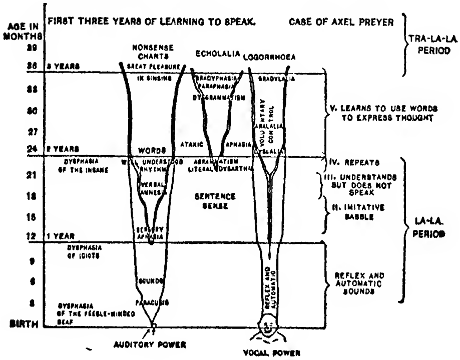

FIG. 2.

(Lukens, *Pedagogical Seminary*, Vol. III, 1894–1896, p. 426.)

power of speech so that he gabbles continually, probably for the purpose of making his possession absolutely secure. Gradually the stage of *logorrhœa* is passed through, and the child has mastered speech and uses it as his social environment requires.

The stages of progress in this series are constantly from the simple and incoördinated to the complex and coör-

dinated. So if we should trace out the series in the use of the sentence, or in hearing words, we should find the same plan followed — the gradual acquisition of the power of coördination so that more and more complex activities may be performed.

The order of losing coördinations in degeneration.

While the evolution of coördination proceeds from the simple and fundamental to the complex and accessory, in dissolution just the reverse course is pursued. Disturbances of coördination are first manifested in the finest and most complex movements. Mercier[1] has pointed out that the most complex and elaborate processes fail first and the most fundamental remain to the last. Wilson has called attention[2] to this in discussing the phenomena occurring in alcoholic dissolution. Degeneration begins with the highest, most coördinated movements of expression, — with purposive movements, — and travels downward to those which are automatic. The voice becomes shaky, and control over the tongue and lips is gradually lost. The drunkard returns over the route he went up in the acquisition of speech, passing through in reverse order the stages of incoördination which he outgrew in childhood. "If the tremors descend to the limbs, they first invade the fingers (not the thumbs), spreading abroad till the whole hand shakes, and creeping up the arms. The lower limbs grow tremulous last of

[1] "Sanity and Insanity," pp. 308–317.
[2] "Drunkenness," p. 40.

all, their movements being largely automatic." Mercier thus describes [1] the process of general undoing under the influence of alcohol. Ribot, too, has emphasized [2] this law of decay in will, whatever may be the cause, from the highest and most complex to the lowest and simplest; from the unstable and most organized to the stable and least organized. Degeneration pursues a course directly the reverse of development; it is a continuous retrogression from the highly to the relatively simple coördinated.

In senescent dissolution the finer and more complex activities are the earliest to become affected. The first evidence of a motor character of the oncoming of senescence is seen in a lack of precise control of the fingers. The old man grows unsteady in his writing. Then his articulation becomes less distinct. And as age proceeds the coördination of all the accessory members is gradually lost. But the vital functions may keep on unaffected. When the old man is wholly unable to care for himself he may still eat vigorously and enjoy his food. He has indeed returned to his second childhood. Again, in death from lack of nutrition, of a person of any age, dissolution proceeds from the extremities inward. One can observe cases of this sort where he can see a reversal step by step

[1] "Sanity and Insanity," p. 317.

[2] "The Psychology of the Emotions," p. 425. See also his "Diseases of the Will," pp. 112 *et seq.*

of the developmental processes, until the individual is brought back to the starting point, where all is gone but certain reflexes, as when an object is put into the palm of the hand it will be seized reflexly and carried to the mouth, — just such a phenomenon as may be seen in the newborn child.

TOPICS FOR INVESTIGATION AND DISCUSSION

1. There is a popular saying that an infant is helpless because it *lacks strength*. If you have an opportunity, make a test upon a young child by straightening out its arms and legs, when they are contracted, and note whether there seems to be muscular weakness.

2. Just what is the distinction between muscular power and motor coördination? Illustrate the distinction with reference to the arm, hand. and fingers, for instance.

3. Do the children whose spontaneous activities you have an opportunity to observe talk louder as a general thing than their parents? What is the explanation of this?

4. Take the hand of a child just learning to write, and guide it in making letters or words. What most impresses you in this experience? What principle of development is involved?

5. What is the effect upon a child's motor expressions of requiring him to perform any task demanding intricate and precise coördination? Observe his facial and general bodily attitudes and movements when he is making the attempt, and note just what occurs.

6. You can easily repeat some of the experiments on motor coördination made by Mr. Hancock (described in the *Peda-*

gogical Seminary, Vol. III, pp. 9–29). Compare your results with his, and say whether they all illustrate the same principle of development.

7. Why is a babe so "clumsy" in its first essays at walking? What is the meaning of "clumsiness" in terms of motor coördination?

8. Are bright children in school more or less "clumsy" than backward ones? Can the bright pupils do better work in writing, drawing, and the like? Can they wrestle better? run faster? jump higher? shout louder?

9. Compare bright and backward pupils with respect to articulation, say in reading. Can you detect a difference? If so, in whose favor? What principle of development is involved?

10. Observe children, from six years onward as far as you can, in their spontaneous motor activities. Do the younger children generally choose occupations requiring precision and elaborate coördination of the accessory muscles, or those involving mainly the fundamental muscles in a comparatively incoördinated and coarse way? Does a change occur as development proceeds? Illustrate with specific instances.

CHAPTER X

FROM FUNDAMENTAL TO ACCESSORY IN EDUCATION

The traditional view of fine coördinations in early education.

MOST of us can doubtless remember the time when the kindergarten quite generally required its little pupils to sew with fine needles which they were obliged to thread for themselves. Its gifts were tiny, and demanded considerable precision of control from infant fingers; and the same was true of the weaving and similar activities. The primary school, too, seemed to proceed on the principle that the smaller the children the finer should be their writing, drawing, and the like. The copy books of a decade ago were ruled so that the beginner had to work in very restricted spaces. Every stroke was made in the effort to keep within narrow boundaries on all sides. It was argued that in this way alone could a pupil become possessed of graceful, artistic chirography. In those days penmanship was a fine art in more senses than one. In drawing, too, it was the fashion to insist at the outset upon mechanical precision. Little allowance was made for an incoördinated motor system; coarse work was regarded as the mark of a lethargic or perverse will. Freedom was not to be tolerated in the novice, for it would lead to careless, slovenly habits. In reading, again, the

orthodox teacher laid great stress upon distinct articulation and "proper" modulation at the outset.

In the words of Dr. Ross, "Until a few years ago the natural order of development was reversed in the education of youth, and especially in female education, so far as this could be accomplished by human contrivance and ingenuity. . . . No sooner had what is technically called education begun than the professional trainer began to exercise the small muscles of vocalization and articulation, so as to acquire the art of reading; the small muscles of the hand, so as to acquire the art of writing; and, in the case of young ladies, the still more complicated movements necessary in running over the keyboard of the piano; while little attention was paid to the development of the larger muscles of the trunk and lower extremities, upon the full development of which the future comfort of the individual depends."[1] But one cannot find quite so much of that sort of thing to-day, though it has not wholly disappeared by any means, either from the school or from the home. One who will visit some of the nurseries in his community will in all likelihood discover that awkward, incoördinated, undeveloped hands are still employed in such enterprises as fine sewing, working with diminutive toys and tools, stringing beads with small eyelets, and so on.

[1] Cf. Oppenheim, "The Development of the Child," Chap. V. Also Burk, *op. cit.*, pp. 58–60.

The natural order is from fundamental to accessory.

The order of development which has been pointed out above indicates plainly that the activities of the child ought at first to employ mainly elemental coördinations involving fundamental nerve centers; and progress should be made slowly to the point where the most accessory nerve processes are extensively utilized. Looking at the matter from a physiological standpoint, exercise should lead to organization proceeding outward from the centers first developed. During the process of maturing, then, centers isolated in infancy would be brought ever more closely together; centers wholly unconnected at the start would be brought into correspondence with one another in maturity. Now, in the development of motor ability, as we have seen, the centers governing the arm as a whole mature earliest; and they should be exercised, and so organized first since they become a sort of thoroughfare for the impulses to the other cortical centers controlling the more distal groups of muscles. It is suggestive that Seguin in the training of the idiot's hand attained the greatest success when he began with movements of the shoulder. The training of these fundamental centers apparently arouse to activity the centers next beyond, and these in turn, if exercised at the proper time, will prepare the way for the functioning of those next in order; and so throughout the whole course of education we should proceed continually from activities relatively central or fundamental to those relatively more peripheral or accessory.

The doctrine of nascent periods.

Our present-day conceptions of human nature enforce upon us the view that there is an *order of development* which *must be* observed in education. What that order is has not been worked out in any detail in respect of many functions, but yet it seems well established for the activity we are considering in this chapter. And there is a growing conviction that if we ignore this order we shall do the child harm. The theory is that every nerve center has its special period of development, and if it is compelled to function before the appropriate time, some disorder will ensue. To illustrate: the optic nerve in a kitten's eye is not medullated until several days after birth, but if the eye be forced open at birth the process of medullation is hastened, but with injury to the nerve and eye.[1]

Hartwell[2] expresses the same thought when, in speaking of the training of speech function, he says that, "In vocal utterance there are three sets of movements, those of breathing, those of phonation, and those of articulation. Breathing is effected mainly by the most central of all muscles, and its movements occur in simplest succession and in brief and simple rhythm. Voice is produced mainly by movements of the larynx — movements that are midway between the central movements of articulation; and the sequence of these movements is intermediate in complexity between those of breathing and those

[1] Burk, *op. cit.*

[2] See Add. and Proc. Inter. Congress of Education, 1893, p. 743.

of articulation. . . . Now advance to the extreme periphery and take the movements of articulation. Each spoken word, like each written word, requires for its formation several movements succeeding each other in definite order at definite intervals; and each sentence is a long sequence made up of many such short sequences arranged in a definite order. The number of different movements of the articulatory apparatus that go to make up even a short speech is therefore enormous, and these movements and sequences of movement occur rarely, and at intervals that are extremely irregular.

"It is important to note here that the three sets of neuro-muscular mechanisms mentioned above are not of the same order. The organs of respiration are the most central or fundamental of the series. The organs of phonation, which give vocal character to the stream of expired air from the lungs, are intermediate, and their neural mechanisms are, therefore, to be considered as accessory in comparison with those of the breathing organs, but relatively fundamental in comparison with the centers which represent the movements of the more peripheral organs of articulation. It is indisputably certain that the young child learns to breathe and cry aloud before it can speak, and that there is a progressive development in his power to imitate and reproduce the consonant sounds, after he has begun to speak. It seems to me that we may safely aver that the law of the evolution

of the nervous system is of great pedagogical importance, since it suggests the natural order which should be followed in training the organs concerned in any complex coördinated movements. For instance, it is transgressing the laws of nature to emphasize the training of the fingers before the neuro-muscular mechanisms of the hand, arm, and shoulder have become thoroughly organized, and their respective movements been brought under control; or to attempt to teach a child to read aloud before he has learned to speak plainly and readily. Dr. H. Gutzmann declares that in fully half of the children who enter school the power of speech is undeveloped."

The appropriate time to develop any power.

Again, modern theory maintains that if a nerve center is not exercised properly during its nascent period, it will be arrested in its development, for it loses its plasticity when the wave of ripening moves past it to other centers. Donaldson has pointed out that the absence of appropriate stimulus during the growing period is for the most part irremediable; and this results, as I have already intimated, not only in the arrest of this particular function, but it influences other functions by interfering with the readiness of association between centers that can become connected only through the undeveloped one. So, too, Crichton Browne[1] has called attention to the fact that organs have a period of growth activity and another of

[1] "The Relation of the Nervous System to Education," Chap. IV of Morris's "Book of Health."

functional activity, and when the latter is beginning to gather strength is the time to make or mar it, and all the functions with which it is in any way associated. The nascent period of any function may by suitable nutrition be prolonged and so a better basis laid for subsequent development, whereas by too great haste or by neglect the opportunity may be lost forever. Burk[1] has mentioned an interesting illustration of the principle here in question. He maintains that beneficial results in developing lung capacity can be obtained only by training during adolescence, when this particular function is maturing. Lung exercises accomplish little or nothing when "perpetrated upon boys under twelve years."

The danger of arrest in development.

It has been said that the development of a function could be retarded by failing to provide nutrition for it at the time when it is ripening; but there is a particular aspect of this principle which I may allude to in passing. A child may be kept performing any low order of activity even when in the natural process of evolution it would be outgrown, or at least the attention would be given mainly to something else. For instance, she could be kept playing with her doll beyond the point where she would spontaneously do so. She might be rewarded in some way for this, or she might be left with nothing else to do, and she would settle down upon this activity when she

[1] "The Influence of Exercise upon Growth," read at the meeting of the Physical Education Section, N. E. A., Los Angeles, July, 1899.

should be moving on to something more complex. The effect of this in her development would be to prevent the maturing of the higher powers. This principle has engaged the attention of many writers in our own day, among others Harris,[1] who has said that if a child at any particular epoch in his development is compelled to repeat any fixed form of action belonging to a lower stage of development, the tendency will be for him to stop at that point, and it will be difficult, if not impossible, to get him up on to a higher plane. Overcultivation of the senses in the early years, or too much drill upon memory, will prevent the development of higher psychical powers. Thoroughness in the pursuit of any study in the elementary school may result in cessation instead of promotion of mental growth.

We have in autobiography many illustrations of this principle. Stillman,[2] for instance, speaks of the effect upon his career of being compelled to study linguistics excessively when he was developing great interest in art, as a result of which he never achieved anything in art because his interest was not seized upon when it was at its height. Higher activities will not develop without adequate nutrition in the shape of appropriate stimuli from the environment. Luckey corroborates the point under consideration when he says that heredity has

[1] "Educational Creeds of the Nineteenth Century," pp. 39–40.

[2] See his "Autobiography."

doubtless given an individual the basis for delicate color perception, but he will not grow up to the highest point of appreciation without stimulations from the environment. The latent powers are called forth through the necessity of employing them in dealing with the world. If the child be shut up in a cave, the color sense will not develop. Heredity only gives the individual a general disposition; experience is necessary to make it definite and conscious. Lloyd Morgan has said that in all probability the experience of the race has left impressions upon the brain of the individual, which, however, except in a few cases, are never expressed in definite action without experience after birth. The few instincts which the child can perform are exceptions to this law, but practically everything which an individual becomes able to do must be the resultant of experience coöperating with heredity. Allin [1] has discussed the principle with relation to the development of the individual as a social being. He says that the latent inherited social traits and characteristics will not make their appearance in the individual's life except in an environment that will call them forth.

This principle of a flood tide in the development of activities seems to have universal application. In intellectual evolution, it is commonly believed that knowledge presented at the wrong time is not assimilated but is lost, just as the seed is which is planted in the untilled

[1] "Social Recapitulation," *Educ. Rev.*, Vol. XVIII, p. 344.

field. So, too, precocity due to forcing a child produces an undue excitement and is apt to exhaust the mind, leaving it sterile forever. "Infant prodigies rarely become distinguished men unless their extraordinary growth be the result not of excessive and abnormal culture but of extraordinary natural endowments." [1] It is a simple enough fact that children are at one period in their development exceedingly eager in the pursuit of some special activity, as doll play, or hammering, or hunting, but they grow through this in time, and take up with something else. V., in his second year, delighted in nothing so much as in throwing. Whenever he could get out of the house he would go to the street and search for some object which he could fling, it made no difference where. But before he was four he lost interest in a measure in this pastime. In its place came hoop-rolling and various games with carts, dogs, and so on. Later still tricycle riding and constructive work in making boxes and the like became prominent, and so the scenes continually shifted. It seems reasonable to suppose that the spontaneous activities of children in some way minister to special needs at particular times; which means, on the neurological side, that certain activities exercise special nerve areas and correlated motor processes when the impulse of growth is upon them. It is conceivable that when a center is awakening there is urgency, *tension* perhaps, in the

The evil of either tardiness or precocity in education.

[1] Compayré, "Psychology applied to Education," p. 41.

motor activities it is designed to instigate, and by exercise a condition of equilibrium is attained. Energy unexpressed results in restlessness; and the discharge of the pent-up forces in appropriate action gives relief and so is pleasurable.

On the educational side this means that we must endeavor to follow in our training the natural order of development of any function, if we can discover what this is. In the matter of motor development, it is clear that the eye-muscles and body-muscles, as well as the nerve-cells, of a child four or five years of age have not attained the degree of maturity essential to perform with safety the ordinary kindergarten exercises of weaving and plaiting and threading. The effort to accomplish these tasks leads inevitably to strain and exhaustion.[1] "When I have seen little ones of four and five years of age," says Oppenheim,[2] "laboriously trying, by straining all their little control of body and will, to put a too fine needle through a series of correspondingly small holes, the thought of kindness turned to cruelty, of good being twisted into bad, has always come to me. In the same category are the exercises of pricking in outlines, of stringing small beads, of outlining with seeds, beads and similarly minute objects." In some experiments conducted upon H. and M., before they were four years of age, I found that the

[1] Oppenheim, *op. cit.*, p. 102.
[2] *Ibid.*, p. 103.

stringing of beads with small perforations would quickly fatigue them. This task always occasioned a good deal of strain and tension, as shown in the contortions of the face, the attitudes of the body, and the contractions of the fingers. After ten minutes of such exercise the average child will grow restless, perhaps peevish and irritable. M., in performing this task at three, became fatigued in a shorter time. After five minutes she would throw away the beads, and could not be induced to continue except by urging, much as the teacher compels the child against his wishes to keep at writing his lesson with a fine pen, for example. I may add that I think most children are delighted with a string of beads, and they will punish themselves to get them, but we are not to infer from this that they are interested in the activity of *stringing in itself*, but only as a means to an end. And even if there should be some pleasure in performing this task, it will be much more marked when the stringing requires less strain and tension.[1]

Judd on the development of peripheral activities

In apparent opposition to the view here presented, Professor Judd[2] maintains that the peripheral muscles are earliest affected by diffuse stimulations, which is just what we might expect when we consider how delicate they are. As an inference from this he concludes that

[1] The energic aspects of this matter are discussed in Part II. I try to show there that excessively fine work, especially on the part of children, results in serious waste of nervous energy.

[2] See the *Journ. of Ped.*, June, 1901.

the warning which has been sounded against finely coördinated movements in the early years has been overdone. There is some reason, he grants, for the crusade against fine work, but it is justified, not because of the immature centers which control the fine muscles, but because of the tendency of the child to use them excessively. "*To say that the large muscles are naturally more active in writing is simply to fly in the face of facts.*" The small movements occur in great abundance as one of the natural results of diffusion, and the tendency on the part of the child is to give excessive attention to them.

Without question the peripheral muscles are in the earliest years readily stimulated, but this is not to say that they are or can be *coördinated in the accomplishment of difficult tasks.* An infant's fingers and toes and expressive muscles are exceedingly active, but not in a coordinated way in the sense in which coördination has been described heretofore. Further, it is not true that a child of two or three, or four or five even, can as a general thing perform intricate peripheral coördinations without undue activity of fundamental muscles. Young children, as I have said above, usually put a lot of force into activities that require only delicate and precise manipulation. The peripheral muscles are not principally employed by the young child in his spontaneous writing, according to my observation. Most teachers have to labor years with children before they can get them to write in their copy

books without *bearing on* heavily. Again, they blot their books because they jab their pens through the paper, and commit many other blunders that are said to be due to carelessness, which in such cases means simply lack of precise adjustment; and this means, for one thing, too great prominence of the fundamental muscles in the coördinating complex.

The doctrine summarized. Mr. Burk[1] has effectively summarized the matter alike in its developmental and in its educational aspects, and his words may be quoted. "(1) As a primary condition which makes accuracy of hand and arm possible, the child must have a matured degree of control under direction of his higher level centres (*i.e.* voluntary). The fact that this maturity is not reached normally, until the ninth or tenth year, renders questionable the efforts of the school to compel accuracy such as is required by the kindergarten, and also by the primary school, in writing, weaving, etc. . . . (4) That for purposes of delicate peripheral movements, as shown by ataxographic experiments, etc., the child has not a matured power of control until well into the school period, and long after severe school requirements of accuracy are demanded; (5) that the evidence goes to show that the sensory-kinæsthetic sensations, essential in psychological theory, for definite voluntary movements are, in general, in a very immature state until eight to ten years; . . . (8) that steadiness of the trunk or central

[1] See the *Journ. of Ped.*, pp. 59–60.

movements (fundamental) necessarily precedes ability to be accurate in peripheral (or accessory) movements."[1]

When one points out the necessity of not requiring of young children too much highly coördinated work he has told only half the story. We must do more than merely avoid doing harm; we must in a positive way plan it so that ultimately the pupil shall be required to perform the most intricate activities of which he is capable, and which may be required of him in the situations in which he may be placed in mature life. We cannot let the child run his own motor course unaided and unstimulated, else he will probably come to a standstill before he has reached the goal toward which we have started him. So by the time the pupil has reached the last years of the elementary school we ought to require of him precise work in his writing and drawing and articulation, and gymnastics and construction work. "Carelessness" may now be treated with some severity, so as to get the pupil into the way of acting peripherally, so to speak. If we let him alone wholly he will tend to remain in the fundamental stage, for these activities lie along the lines of least resistance. But in mature life, under present conditions, one's welfare depends in very large degree upon his ability to do exact, precise, fine work; and he is not likely

[1] Baldwin, in the *Journ. of Ped.*, June, 1901, makes statements very similar to those made by Burk. See also the following: Rowe, "The Physical Nature of the Child and How to Study it," chapter on Motor Ability; Kirkpatrick, "Fundamentals of Child-Study," Chap. V.

to develop this ability entirely of his own accord. The school must urge him somewhat. In no other way, it seems, can he be brought to the point where he can deal effectively with the extremely complex environments into which he will be cast at maturity.

TOPICS FOR INVESTIGATION AND DISCUSSION

1. When you entered the primary school were you expected to write with pen and ink in a precisely coördinated manner? If so, what has been the effect of such an experience upon your later development?

2. See if you can secure some thoroughly reliable evidence upon this question: Will those persons who are required in the early years in school to write very slowly and precisely have a more efficient mastery of penmanship in maturity than those who are encouraged to write freely and boldly, with slight reference to mechanical, technical, or æsthetic perfection?

3. Observe children writing with (*a*) fine-pointed pens; (*b*) hard lead pencils; (*c*) soft lead pencils; (*d*) chalk on the blackboard. If given freedom, which will they choose? Which can they continue at the longest without fatigue?

4. Comment on the policy of many schools of exhibiting only the penmanship of pupils of all ages, the purpose being to stimulate them to be mechanically accurate.

5. Comment on the policy of many schools of marking down all written work if the penmanship is not mechanically perfect, no matter how excellent may be the thought expressed.

6. Secure all the evidence you can on this question: Is mechanically perfect penmanship an aid or a hindrance in the expression of thought? Are the most vigorous and effective

thinkers the best writers, judged by the standards of those who insist on mechanical perfection?

7. Suppose a child of five years should come to school to you, and he should be deficient in articulating all intricate sounds, as the *ng*'s on the ends of words, for instance; what, precisely, would you do in training him to articulate?

8. If you have sewing in the primary grades, do you use needles with small eyes, requiring the pupils to do their own threading? Discuss the principle involved, and apply it to all activities in manual training.

9. Would you require pupils of any age to perform tasks requiring precision and intricate motor coördination? Be specific with respect to ages and tasks.

10. Would you advise parents to provide small playthings for their young children, — tiny dolls, small building blocks, diminutive, fragile dishes, and the like? Why?

CHAPTER XI

RÉSUMÉ

REVIEWING the ground we have covered, we have seen that motor activity is the chief characteristic of the young; whatever passes within tends to work out into appropriate conduct. Arms, legs, vocal organs, and body as a whole are continually in action during waking life, and to some extent even during sleep. "The child thinks with his muscles" is coming to be an accepted doctrine.

The infant lacks inhibition almost wholly. He gives way easily to all his emotions and passions. Every stimulus appears to issue directly in some form of action. Only when his attention is held by a story, for instance, can he keep his muscles quiet, and then but for a very brief interval. However, control increases with development. Regarded from the neurological standpoint, inhibition depends upon using energy at one point and withdrawing it from other points. So as the child's imaging activity increases, his muscles gradually lose their prominence. In cases of degeneracy, though, just the reverse of this process occurs; inhibition is gradually lost. This phenomenon is seen in insanity, old age, inebriety, and so on.

If inhibition be imposed upon the child too early, it will interfere with his mental development. In the early years, especially, mind functions to direct action; and if the latter is impossible, there is no incentive to the former. Static education should have no place at any period in the pupil's life, but it is particularly ineffective in the kindergarten and elementary school. Action is necessary, in the first place, for the development of cerebral motor areas, upon which the development of the sensory and associative areas seems to depend in some measure. Further, the child can acquire a genuine understanding of a thing only as he has motor experience with it, as he *does something with it.* Eye and ear knowledge alone are of little profit. However, as the pupil develops past motor experiences may apperceptively give him understanding of present situations without reacting upon them in a motor way; but we must be sure that *he has had motor experience with similar situations.*

When we come to the school we find that motor activity has not yet received general recognition, though the ideal of static education is passing. Reform has begun in the kindergarten, but even the kindergarten is not yet wholly free. It still tries to feed babes on abstract truths for which their mental digestive organs are wholly unprepared. Nothing should be taught, in the kindergarten or elsewhere, that cannot be *lived, worked out into conduct, established in motor experiences;* this is the first educational

law. The dynamic side of every study — arithmetic, language, science, geography — must be made most prominent.

Manual activities must have a prominent place in early education. The real value of manual activities is found in their beneficial influence upon the intellectual and ethical phases of the child's nature, though they affect happily his whole being. The child's greatest interest is in constructive activities, and manual training should seize upon this interest and provide for its realization. It is significant that in the training of defective and delinquent children manual activities are given chief place at the start.

Manual training, in order to be of value, must follow the lead of the child's interests, and not run off on a formal, logical tangent. The child should get aid from his manual training to carry on his imitative play outside of school. He should be helped to *make things* in which he is interested. In general, the child in his constructions will follow the race in its industrial evolution. This implies that he will not begin by making objects mathematically and æsthetically excellent, though structurally simple, as a sphere or a cylinder. A crude house is more simple to a child than a cylinder precisely made.

There are certain limitations to the value of manual activities. It is a mistake to think that the will is trained more perfectly by the hammer and the saw than by other

educative materials. Honesty and kindred virtues developed with reference to physical situations may not be available in social situations. As the pupil develops, a less and less prominent place should be given to manual training, except in the case of the student who will spend his life in the pursuit of a trade.

Although the child comes among us fitted out with an elaborate kit of tools for operating upon the world, still he is entirely lacking in the knowledge of how to use them. His earliest activities are not adaptive; his life is at first entirely subjective. In gaining adaptive activities he must pass through a stage of random action wherein some of his movements accidentally hit the mark; that is, they yield him pleasure in some form. He tries to have these successes repeated; and just because they are beneficial they are repeated more often in the general spontaneity of the child than the useless or injurious activities. This results in the adaptive activities coming gradually to be the only ones performed; the others die out from lack of use. This is in outline the natural history of every adaptive action; though as the individual acquires a body of elementary activities he can employ these in the complex acts into which they enter.

The learning of any new act involves excessive activity at the outset. The novice cannot hit the mark the first time. He must make many trials; and when he accidentally succeeds he will discover just what processes are

essential to the performance of his task, and then he will have some guide for the operation of volition in succeeding trials. This principle of learning holds throughout life; but as the individual develops he becomes possessed of an ever increasing stock of motor ideas which he can bring to the execution of any new task, so that he can perform it more readily than he could in the beginning. In adult life we have already mastered the elements of all the arts, games, etc., we are required to learn, and the new factor consists simply in combining these elements into series or patterns or complexes. It may be added that probably very few of our actions are learned absolutely *de novo;* we gain something from racial experience, but we must develop the negative, as it were, by our own experience.

Imitation is a peculiar form of adaptive activity. Every imitative act, however, must be learned in the manner that has been indicated above. An individual cannot imitate an act until he can perform the action himself deliberately. When a child tries to imitate a complex act, he will reproduce only so much of it as he has himself performed spontaneously. We see and hear in terms of our motor habits, in considerable part at least.

In acquiring any art the child must pass through the "scribble" stage, wherein motor processes are but slightly controlled or directed by mental images. When the child begins writing he has little appreciation of literal

forms to be reproduced. In teaching any art, the first thing to do is to give the child the motor data essential to the performance of the art. It will accomplish little to command the novice to "pay attention" or "be more careful," and the like.

At the outset the child has only very slight, power of coördinating various parts of his organism in the execution of intricate tasks. People have always recognized this, but they have said it was due to lack of strength. However, the child has muscle enough, but he cannot use it advantageously, except in a few instinctive ways. Central or fundamental movements predominate at the outset, and the wave of development moves outward toward the extremities. The young child is long in gross muscle but very short in coördination of the most accessory parts of his organism, — fingers as used in writing, tongue as used in speech, etc. He puts a relatively large amount of force into the performance of even the most delicate tasks. He might be called a biceptual creature. As development proceeds, the energy is distributed ever more largely over the whole of the manual, vocal, and pedal systems, instead of being expended entirely upon the fundamental parts of each. In speech as in manual activities the child is at first forceful rather than delicate, crude rather than refined, central rather than peripheral minded.

In an earlier day it was thought that the child, being

small, should be required to use small implements in all his work, and perform fine, delicate tasks. But the rightful order of education, following the natural order of development, is from fundamental to accessory. Coarse, crude, rapid work must come before refined, delicate, painstaking work. Peripheral is conditioned by central development; if the latter is neglected, the former must suffer.

On the other hand, if we permit the child to take his own gait he will be likely to stop upon some low stage of development. To keep him at coarse, crude work continually would be a serious mistake. We must set the pace for him by always keeping him striving to accomplish tasks just ahead of his present stage of evolution. We must avoid either tardiness or precocity in his training.

PART II

THE ENERGIC FACTOR IN EDUCATION

CHAPTER XII

ACTIVITY AS REQUIRING THE EXPENDITURE OF ENERGY

The mind as the body's guest.

FROM the earliest times men have endeavored to ascertain just what is the connection between the physical and the mental in the human organism. This has been the subject of primary importance alike for mythology, for religion, for philosophy, and in our own day for experimental science. The conception of the mind most characteristic of primitive reflection, in the individual as in the race, regards it as a tenant of the body, or the "body's guest." This notion does not imply any *organic* connection between mind and body. There is but a sort of tangential relation, so to speak; and the spirit can if it chooses free itself wholly from the domination of the "wall of flesh" in which it is momentarily entombed. It is only when one's will is lethargic or perverse that he yields to the promptings from the body, which, unhappily, are usually of an evil sort.

Holding this view men believed during long epochs that they ought to scourge the body that they might thus purify and elevate the mind. If the animal be not held in subjection by such discipline it will corrupt the spirit. This doctrine, it is needless to say, is quite in contrast to the theories of these later days, when it is maintained by most men that the more respect we pay the body, the kindlier and more faithfully we attend its needs, the greater will be the reward in spiritual exaltation and freedom. Locke tells us we can have a sound mind only in a sound body; and Rousseau shows us the other side of the shield when he tells us that a weak body enfeebles the mind.

Mind as matter.

In the early stages of the development of physiology and kindred sciences there sprung up a theory respecting the relations of mind and body directly opposed to that mentioned above. In an ultimate analysis, it was said, mind can be reduced to material terms. This conception seems rational enough from one point of view, since the phenomena observed on the occasion of injury to or degeneracy of the central nervous mechanism lend themselves readily to such an interpretation. People remark that if the brain suffer damage from any cause some mental defect or deficiency usually ensues; and when for any reason the cerebrum becomes inactive, there is no evidence of any supra-cerebral activity remaining. So far, in short, as we can observe mental manifestations

ab extra, they appear to be directly dependent upon, or even aspects of, neural functioning. This second view, then, makes the mind a phase or phenomenon of matter, a sort of reverberation resulting from the breaking up of highly organized cellular bodies.

The energic relation of mind and body.

There is yet a third view advanced by philosophers and scientists like Lotze,[1] Darwin,[2] Romanes,[3] Wallace,[4] Fiske,[5] Wundt,[6] and James,[7] which regards the mind and body, so far as it passes opinion upon the nature of each, as distinct entities, but in some inexplicable manner bound to each other in such a way that activities of the one occasion correlated activities in the other. This is doubtless the principle Sterne has in mind when he says, in "Tristram Shandy," "A man's body and his mind . . . are exactly like a jerkin and a jerkin's lining; — rumple the one . . . you rumple the other." The adherents of this doctrine pin their faith to what may be styled a dynamic, or better an *energic*, relation between mind and body. Modern experimental science gives us the doctrine that "every psychosis is accompanied by a neurosis," although, of course, complete and final evidence upon

1 "Microcosmus."
2 "Descent of Man."
3 "Mental Evolution in Man."
4 "Darwinism."
5 "Destiny of Man in the Light of his Origin."
6 "Human and Animal Psychology," pp. 5–7 and 440–445.
7 "The Will to Believe," chapter on Reflex Action and Theism.

this subject is for the present, at least, quite beyond the ability of science to obtain.[1]

But it seems reasonably certain, for one thing — the only one that concerns us here — that all mental activity involves the expenditure of energy generated by nerve cells. The architecture of the cell, in the absence of more positive experimental data, would of itself lead one to this inference. The plan of construction is simple. There is a central body or nucleus which serves the purpose of husbanding resources, as it were; and connected directly with this are fibers or pathways some of which are designed to convey stimuli from the world without to the nucleus of the cell, whereupon energy is released, while other fibers convey the liberated energy to other cells, and ultimately to the muscles, probably. (See Figs. 3, 4 on following page.)

Familiar evidence that all activity expends nervous energy.

The substances within the nucleus are believed to be of a highly complex and unstable chemical composition,[2] in consequence of which they are easily broken down, the static energy of their union thus being set free. Neurology assumes that all mental and motor action requires

[1] For the opinions of investigators, as Mosso, Lombard, Maggiora, Kraeplin, and others, see the *Ped. Sem.*, Vol. II, No. 1, pp. 13–17; Scripture, "The New Psychology," Chap. XVI, and *The Educ. Rev.*, Vol. XV, pp. 246 *et seq.*

[2] Ladd, in his "Physiological Psychology," pp. 13–14, gives the following formulæ of some of the substances: Protagon, $C_{116}H_{241}N_4O_{22}P$; Cholesterin, $C_{26}H_{44}O + H_2O$.

for its initiation and maintenance the expenditure of some of this force held *in potentia* in the nuclei of nerve cells. People do not commonly appreciate this, in part because they do not reflect upon the matter, though even careful introspection reveals thought as a spiritual activity dissociated from, or at least not dependent upon, nervous

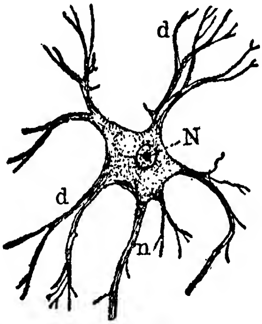

FIG. 3.

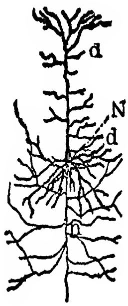

FIG. 4.

FIGS. 3 and 4. — Representations of typical nerve cells (Donaldson, "Growth of the Brain," pp. 143 and 145) designed especially to show the elements concerned in the reception of stimuli, *d*; in the generation and storage of potential nervous force, *N*; and finally in the transmission of kinetic nerve energy, *n*.

functioning. It is not easy for me to conceive that my ideas are linked to nerve cells, and remain dormant except when these are active; and it matters not for the present which is cause and which effect. But if one will note some of the very obvious bodily accompaniments of his thinking he will not lack for opportunities to see that arduous mental

work often sets the blood flowing headwards, which is shown in distention of blood vessels and in a sense of pressure or strain in the cephalic regions. Every student at least should know that continued study often increases the temperature about the head, and leaves the extremities — hands and feet — cold.

These phenomena are easily observed in simple psychological experiments, wherein it is possible to show that when a subject exerts his mind in the effort to solve a difficult problem, for example, the volume of blood in the cerebral locality increases. It was the physiologist, Angelo Mosso,[1] I believe, who first demonstrated this fact experimentally with the plethysmograph. And he was able to illustrate the same phenomenon in another way. A subject was placed upon a delicately constructed balance which remained horizontal while his mind was comparatively at rest, or at least in a quiescent state. But when he was summoned to severe intellectual effort, or when

[1] Reference is made to this phenomenon in Mosso's "Fear," p. 68. The subject is treated in detail with respect to methods of investigation and results, in "Die Ermüdung," pp. 195 *et seq.* (Since these chapters were written Mosso's "Fatigue" has been translated; New York, Putnam and Sons, 1904.) There is a good *résumé* of recent investigation relating to the effect upon circulation of intellectual and emotional activity, together with the presentation of results of original researches, in the *Psych. Rev.* for January, 1899, by Angell and Thompson, — "The Relation between Certain Organic Processes and Consciousness." The best work on this general subject, however, is Binet and Henri, "La Fatigue Intellectuelle," to which reference will be made later.

any lively emotion was aroused, the balance tipped in the direction of the head, indicating that the blood was surging brainward, and so away from the limbs.[1] Key[2] declares that intense mental activity among the upper classes of Sweden has resulted in a marked increase in the tendency to nosebleed. The rise in cerebral temperature during intellectual effort has been studied by Lombard, Schiff, and others by means of the thermoelectric needle plunged into the brains of dogs and other animals. When in this latter case any sense was stimulated, as smell, the needle if placed in the olfactory region of the brain seemed to show that heat was being liberated.

Some physiological evidence.

The significance of these well-known, but yet little appreciated, phenomena becomes apparent when they are interpreted in view of the accepted explanations of similar phenomena occurring during muscular exertion. It is a simple physiological fact that the volume of blood in a muscle is greater when it is active than when it is at rest, due doubtless to the need of removing and repairing the increased waste produced by the breaking down of cells in consequence of work. Now, it may be readily inferred that the increased cerebral circulation attending vigorous intellectual or emotional activity occurs for the purpose of removing waste, and supplying nerve cells with nutritive

[1] Cf. Binet and Henri, *op. cit.*, pp. 81 ff.

[2] See Kotelmann, "School Hygiene," p. 219.

materials. Physicians like Cowles,[1] Beard,[2] and Mills[3] say that certain toxic or waste products of nervous action increase *pari passu* with intensified intellectual or emotional activity. Nervous as well as physical action seems to result in the production of a sort of débris in the system, which is, as we might expect, just worn-out or degraded tissue, and which may accumulate to such an extent as to disturb the normal functioning of the nervous system. Especially does it tend to throw out of gear the inhibitory apparatus, paralyzing the fatigue sense, as some one has said, and thus removing the natural checks to excessive physical or mental activity, when the organism may continue to exert itself beyond the safety limit.

The experiments by Hodge,[4] though their worth is questioned in some quarters to-day, still seem to show, in the case of animals at any rate, that activity of a nerve cell depletes the nucleus of its contents to a greater

[1] "Neurasthenia and its Mental Symptoms."

[2] "Neurasthenia."

[3] "Mental Overwork and Premature Disease among Public Men," Smithsonian Institute, No. IX of Toner Lectures. See also, in this connection, Wood's "Brain-work and Overwork" (Philadelphia, 1880) and Richardson's "Diseases of Modern Life" (London, 1876).

[4] See the following articles: "Some Aspects of Electrically Stimulating Ganglion Cells," *Am. Journ. Psych.*, Vol. II, pp. 376 *et seq.*; and the "Process of Recovery from Fatigue occasioned by the Electrical Stimulation of Cells of the Spinal Ganglia," *Am. Journ. Psych.*, Vol. III, pp. 530 *et seq.*

or less extent, revealed in a gradual shrinking while stimulation continues, as shown in Figs. 5 and 6. This phenomenon, which he was able to detect while experimenting with a living cell under stimulation, was observed also in the examination of animals at night after a day's work, and in the morning when they had passed a long period in rest. In the first instance the nuclei of the cells were shrunken, while in the morning they presented a repleted appearance, indicating that the activities of waking life had resulted in partial exhaustion of their stock of force-producing materials.

The theory of fatigue.

The last point leads us directly to the subject of fatigue, which is coming to occupy so prominent a place in educational literature. We are told that one important function of the nervous system is to generate and distribute the energy needed to carry on both mental and motor activities. Now, theoretically there is in every individual case a point beyond which energy cannot be expended without considerable disturbance to all the functions of the organism. If this disturbance be but momentary, one is said to be "weary," or "tired," but if it continue for a long period one is said to be fatigued, or exhausted. In recent years psychologists and physiologists have been unusually active in experimenting with individuals to determine the "course of power," with respect to a wide range of activities and under a great variety of conditions. They have been par-

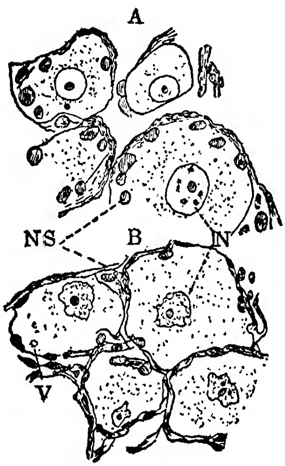

FIG. 5.

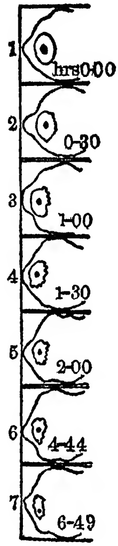

FIG. 6.

FIG. 5.—Two sections, *A* and *B*, from the first thoracic spinal ganglion of a cat. *B* is from the ganglion which had been electrically stimulated through its nerve for five hours, *A* from the corresponding resting ganglion. The shrinkage of the structure connected with the stimulated cells is the most marked general change. *N*, nucleus; *NS*, nucleus of the capsule; *V*, vacuole × 500 diameters.—HODGE.

FIG. 6.—Showing the change observed in the nucleus of the living sympathetic nerve cell of the frog, as the result of electrical stimulation. At the beginning of the experiment the nucleus is seen to be replete with what we may call potential nerve energy; but after thirty minutes of stimulation it appears somewhat shrunken, and the shrinking increases as the experiment proceeds. At the end of six hours and forty-nine minutes the shrinking of the nucleus is very marked.—DONALDSON after HODGE.

ticularly interested in the work of the school, and some of their reports have aroused teachers and parents and physicians in an unusual manner. Throughout the civilized world laymen are apprehensive lest the schools should make too heavy demands upon the energies of the young. And not only are laymen worrying over this matter, as is evident from the vast amount of literature appearing on the subject, but physicians are even more troubled. In Germany, in France, in England, and in America bodies of medical men have expressed their disapproval of our modern educational régime because it overtaxes the pupil. The Academy of Medicine in Paris, as early as 1886, ascribed a long list of children's diseases to school fatigue, and the list has been added to by the medical men of our own country. The word has gone out from men who ought to know that we are sapping the vitality of the rising generation, and there is great anxiety and even dismay in the educational camp.

Methods of investigation.

We must glance a moment at the methods men have adopted in determining the extent to which children are being overworked in the modern school. To begin with, Mosso made use largely of the ergograph,[1] which is designed to measure the amount of force that can be exerted through the middle finger, say, under varying conditions. He did not himself employ it in the study of schoolroom activities, but some of his followers have done so, for

[1] See his "Die Ermüdung," Chap. IV.

instance Smedley, of Chicago. I have elsewhere[1] presented the results of some experiments with the ergograph, together with the inferences that have been drawn from them, and I need not delay upon these matters here. It should be indicated, however, that the latest research has apparently shown that the ergographic tests for fatigue are altogether unreliable. What may at first sight appear to be due to fatigue may upon more critical analysis be seen to be caused principally by other factors, as Ellis,[2] Thorndike,[3] Bolton,[4] and others have indicated. A pupil who may in the morning put forth his best efforts on the ergograph, because it is novel to him, may do poorly at noon or at night because the thing has lost its novelty. His decreased vigor may be due rather to lack of interest than to lack of energy; he may have an abundant supply of the latter if it could only be tapped. It is conceivable that a boy whose ergographic work at four o'clock in the afternoon would be quite defective could engage in a game of baseball with great enthusiasm and efficiency; indeed, we have doubtless all seen cases that illustrate the principle. Then there is some pain experienced in operating the ergograph, and this would act as an inhibition upon effort. Thus other factors besides the energic one may play an important part in deter-

[1] Mainly in Chaps. XIII and XVIII.
[2] See the *Am. Journ. Psych.*, Vol XIV, pp. 232–245.
[3] *Psych. Rev.*, Vol. VII, pp. 466 ff.
[4] *Psych. Rev.*, Vol. VII, pp. 136 ff.

mining how great an exertion the individual will make, so that the experimenter cannot be sure of his results. The difficulty is due to the fact that investigators have regarded the failure to put forth effort as being due to one cause, whereas there may be many causes at work. It is a very complex, instead of a very simple, affair.

The criticism of the ergographic test will apply fully to many of the others, — the tests with the æsthesiometer, for instance, to which Griesbach and his followers have attached so much importance. Students of Griesbach's method, such as Leuba,[1] have shown that there may be many factors, instead of one — fatigue — operating to influence a pupil's ability to discriminate simultaneous touches on the skin. The writer has conducted many tests with the æsthesiometer, and he has always felt that suggestion was an extremely disturbing element, rendering the results of the experiments more or less worthless. If the test be long continued, the subject easily tires, and goes wide of the mark; but the thing we are measuring then is not fatigue in the proper sense, but only momentary weariness. Lukens[2] has called attention to this point, and it is of the utmost importance. Then, as Leuba[3] reminds us, conditions affecting the peripheral organs will have an influence upon sensitivity in the æsthesiometric tests, as will also the subject's emotional tone at the

[1] See the *Psych. Rev.*, Vol IX, pp. 138 ff. [3] *Op. cit.*

[2] See the *Am. Phys. Ed. Rev.*, Vol. IV, pp. 20 ff.

time, his interest in the test, his general bodily condition, and the like. So studies upon pupils with the æsthesiometer must be regarded as only suggestive in a very general way.[1]

Binet and Henri, and numerous other investigators, have studied the influence of intellectual work and of fatigue upon vital function, as measured by the sphygmograph and other instruments working on the same general principle. They have studied the influence of intellectual work upon circulation, for instance, as shown in the number of pulsations, the volume of blood in the brain, the volume of blood in the hand, the pressure of the blood, and the dicrotism, or double action, of the pulse beat. In the same way they have studied the influence of intellectual work upon respiration as indicated by the rapidity of respiration, the amplitude of respiration, the amount of carbonic acid gas expired, and the amount of oxygen gas absorbed. They have further investigated the relation between intellectual work and the temperature of the body, and the *exchanges nutritifs*. The results of these investigations are of great service as showing an intimate relation between mental activity and nervous and vital function, but they have not yet been made detailed or definite with respect to the question of fatigue. We have gained practically nothing from this

[1] See Binet and Henri, *op. cit.*, pp. 320–321, for a statement of the mechanical difficulties attending the use of the æsthesiometer.

source regarding the amount of intellectual work children of different ages may safely undertake, how long should be the school year and the daily sessions, whether some studies dissipate vital force more rapidly than others, and so on.

Thus far we have noticed only the moro distinctly physical methods of studying the course of power, and we must now mention the strictly mental tests. There are four favorite tests that have been largely used by Gikorsky,[1] Bürgerstein,[2] Ebbinghaus,[3] Höpfner,[4] Friedrich,[5] Binet and Henri,[6] and several investigators in our own country, as Holmes,[7] for example. There are the number tests, wherein pupils are required to add, multiply, and divide series of numbers at various hours during the day, after given periods of mental application, after intermission, and so on. The rapidity and accuracy of the work done are studied, and the results charted, to see if there is any tendency toward increase or decrease holding for the majority of pupils. Then there is the dictation test, where numbers, letters, or literary selections are dictated to pupils at various times during the day, and the

[1] See Binet and Henri, *op. cit.*, p. 288.
[2] See the *Zeit. fur Schulgesundheitspflege*, 1891.
[3] See *Zeit. für Physch. u. Phys. d. Sinn*, Vol. XIII, pp. 401 ff.
[4] *Ibid.*, Vol. VI, pp. 191 ff.
[5] *Ibid.*, Vol. XIII, pp. 1 ff.
[6] *Op. cit.*, "Deuxième Partie," Chap. II.
[7] *Ped. Sem.*, Vol. III, pp. 213 ff.

rapidity and accuracy of the work studied. So there is a memory test, and a test wherein the pupil is required to fill in omissions in a literary selection, so that the sense is preserved. We shall in the appropriate place see what results have been reached by these different methods, but it should be noted here that there are disturbing factors which make it unwise to place too great confidence in these results. What Binet and Henri call *ennui* may and probably does affect seriously the response of pupils after the novelty of the tests has worn off. Then the personality of the investigator will determine the attitude of the pupils, and influence the vigor of their attack upon their tasks. Thus a variety of factors may contribute to determine the results of any experiment when the investigator may ascribe all the results to but one factor.

So it can be seen from this hasty glance at methods of investigation that fatigue in the true sense is not easily measured, and what often passes therefor may be really something quite different. We may not find it possible, then, to speak positively and in much detail respecting the precise amount of school work which should be required of pupils; but there is one matter of great practical importance, and concerning which we may speak with much definiteness,—the waste of nervous energy through ill-suited experiences. It will probably be agreed to by every one that life is growing constantly more complex, and an individual must be more effective than ever if he

would become adapted to his environments. This means that he will need to generate more energy than his ancestors did, and not expend it without profitable issue. Education, then, must be as economical as possible of a pupil's energies; and to point out methods of accomplishing this will be the purpose of the following chapters.

TOPICS FOR INVESTIGATION AND DISCUSSION

1. Have you observed in your own case that vigorous or prolonged intellectual activity influences the circulation of the blood? Does it increase blood pressure in one region and reduce it in others? Be specific respecting the evidences upon which your answer is based.

2. Observe carefully pupils in different grades of the school; is there any way you can tell "with the naked eye" whether intense intellectual activity augments the volume of blood in the cephalic regions?

3. Discuss this proposition: People have always realized that an individual possesses a limited supply of energy which may be exhausted by excessive work, either mental or physical. What are the evidences that the people you know entertain such a conception of human nature?

4. What is the distinction between these terms: *weariness; fatigue; exhaustion?*

5. Could a pupil be "tired" of any task, and yet not be fatigued? How can you tell whether a pupil is fatigued or only afflicted with *ennui?*

6. Have you ever observed pupils who appeared weary or fatigued, but who brightened up and attacked their lesson

vigorously when different methods were employed by the teacher? Illustrate with particular instances.

7. Take a school, at 11:45 A.M., say, in which the pupils are working slowly and making many errors; mention all the factors that may possibly be the cause of this unhappy condition.

8. In the light of your own observation and experience, point out the merits and the defects of the various methods of investigating fatigue mentioned in the text.

9. What do you think would be the value for scientific or practical purposes of asking pupils if they felt weary or fatigued?

10. Describe any reliable and practicable test for fatigue which a teacher could make as a part of her regular daily exercises. Be certain that it will be a test for fatigue, and not other factors and conditions.

CHAPTER XIII

THE INFLUENCE OF FATIGUE[1] ON THE EFFICIENCY OF MIND AND BODY

The nervous system as a storage battery.

We are coming to conceive of the central nervous system, from one point of view, as a reservoir of energy which may be employed in carrying on the activities alike of body and of mind. Now when one's nervous resources are expended in the support of particular activities, other activities must be neglected. To illustrate, when one spends himself in extraordinarily hard muscular labor, he is usually less keen and vigorous in his mental processes; and the reverse seems also to be true. Again, when one's energies are utilized in repairing the ravages of disease, he is unable to expend much force, relatively speaking, in the accomplishment of either physical or mental tasks.

Investigators, such as Mosso,[2] Lombard,[3] Maggi-

[1] I shall use the term *fatigue* in the sense in which it is used by Mosso, Binet and Henri, and most other students of the subject. Woodworth (the *Psych. Rev.*, Vol. IX, p. 181) uses it to denote a more serious depletion of nervous energy, amounting to exhaustion. It would seem desirable to keep the latter term for the extreme forms of fatigue.

[2] "Über die Gesetze der Ermüdung," *Archiv für Phys.* (DuBois Reymond.) Hefts, I, II, 1890.

[3] "Some of the Influences which Affect the Power of Voluntary Muscular Contractions," *Journ. of Phys*, Vol. XIII, pp. 1, 58.

The effect of fatigue on muscular action.

ora,[1] Kraeplin,[2] Bryan,[3] and many others have studied experimentally the effect of excessive work of various sorts upon intellectual and motor action, and we may summarize in this chapter what appears to be the best established and most practical results of their researches. To begin with, excessive work lessens the force and reduces the rapidity of muscular action;[4] and this, according to Mosso,[5] is no doubt to be accounted for in part by the fact that what we are wont to call muscular fatigue is in truth largely central or nervous fatigue. It has been shown that when a subject under experiment is made to exert as much force as he can by means of the hand grip on a dynamometer, say, until his muscles appear to be entirely depleted, they may then be stimulated by electricity to act with about as much vigor as they did at the start, indicating that they are still in working condition; and after a period of stimulation in this way, the will of the subject remaining at rest, he can again voluntarily energize his biceps, as is indicated in Figs. 7 and 8 on following page.

This principle in its general bearings is often recog-

[1] "Über die Gesetze der Ermudung. Untersuchungen an Muskeln des Menschen," *Archiv fur Anat. und Phys.* (DuBois Reymond.) *Physiologie*, 1890, pp. 89–243.

[2] "A Measure of Mental Capacity," *Pop. Sci. Mo.*, Vol. XLIX, p. 756.

[3] "The Development of Voluntary Motor Ability," *Am. Journ. of Psych.*, Vol. V, pp. 123 *et seq.*

[4] Cf. Bergström, *Am. Journ. of Psych.*, Vol. VI, p. 265.

[5] "Fatigue," p. 243.

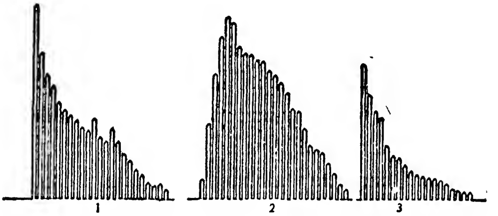

FIG. 7.—Showing ergographic tracings, (1) in voluntary effort, (2) in electrical stimulation of nerve, (3) in electrical stimulation of muscle. (Scripture,[1] after Mosso.) The relative heights of the tracings represent the relative amounts of energy expended in the several forms of stimulation. It can be seen that in voluntary effort the subject gradually loses power of exertion and is soon unable to exert any force whatever; but if at this point a nerve leading to the muscle which has been acting (in this instance the middle finger was exercised) be excited by electricity, the tracings show that the muscle is as vigorous as ever. The fatigue in the voluntary effort must then have been central or nervous. Again, if when action ceases from nerve excitation the muscle be directly stimulated there is once more a return of power, indicating that the muscle itself fatigues much more slowly than the nervous mechanism concerned in voluntary effort.

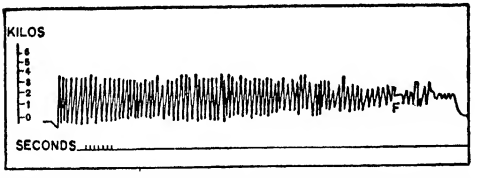

FIG. 8 shows the rhythm in the fatigue of voluntary effort (Scripture[2]). At *F* is shown a period when the subject could exert no force whatever, although he earnestly endeavored to. Soon after this space of paralysis, however, there is a return of ability again for a brief time. These tracings were obtained upon the dynamometer by means of the hand grip.

1 "The New Psychology," p. 231.
2 *Ibid.*, p. 229.

nized practically in every-day experience, particularly in the training of athletes. It is well known that their physical vigor and endurance depend in great degree upon their mental condition (see Fig. 9), or, as the saying goes, upon their "nerve." They are expected during the season of training to secure an abundance of food

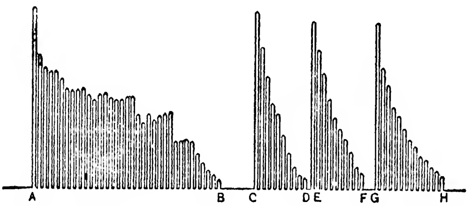

FIG. 9 shows the effect of mental work upon the power of contraction of the finger at various hours of the day. (Mosso, *loc. cit.*) The first curve, from *A* to *B*, indicates the amount of work which could be done at 9 A.M. From 2 P.M. until 5.30 P.M. the subject was under great mental strain while conducting an examination in the university. After the examination, at 5.45 P.M., the curve from *C* to *D* was gained. The first contraction of the finger shows as much power as in the morning, but the energy is soon exhausted. Then after supper, at about 7.30 P.M., the curve from *E* to *F* was taken, and it indicates a slight increase in the endurance of energy. Finally, at 9 P.M., the fourth curve was made, showing a slow recovery of original power.

and sleep, and to abstain from dissipation so as to keep the nervous system in thorough repair. People often say that when they have been greatly frightened, or after a severe mental strain of any sort, they are "weak in the knees." They can exert but little muscular force of any sort at such a time. After a hard day in the school-

room teachers are often disinclined to engage in any physical activities; they feel "tired," they say, though they have not been using their muscles at all. It is the brain that is "tired" in such cases, and so it is unable to stimulate the muscles to vigorous action.

Effect of fatigue on motor co-ordination

One manifestation of fatigue very much in evidence in the daily life of children, as I have observed them, is the inability to perform intricate motor tasks, such as fine sewing or writing, for instance. The explanation is doubtless found in the fact, already referred to, that particular cerebral areas have special control of particular motor activities, one area having charge of the coarser coördinations, as walking, hammering, and the like, while other and "higher" areas have special control of more peripheral and complex movements. These last areas may be regarded as the coördinating mechanisms, *par excellence*, of the nervous system.[1] Now, in fatigue, as in intoxication or brain disease, these areas seem to be generally affected first, because they are the most unstable; and nervous depletion will then be manifested early in relative inability to execute very precise or elaborate coördinations.

This is responsible for much of what in the schoolroom is called "carelessness," one of those terms which denote a lack of critical analysis, grouping, and inter-

[1] This conception is worked out in detail in Mercier's "The Nervous System and the Mind," Chaps. III–VI.

pretation of phenomena. A pupil in a condition of fatigue who tries to write with a fine-pointed pen, for instance, is likely to make many blunders. He will blot his copy book, perhaps, or get his fingers inky, or make ragged lines, and so on, when ordinarily he could avoid these disasters. Servants, as I think I have observed, break more dishes at night, after a hard day's work, than at any other time. I have noted particularly that kindergarten children kept too long at stringing beads or fine weaving or sewing grow "careless," and make little headway. Many people have the experience that when they are fatigued[1] from any cause the voice becomes unsteady, the hand trembles, and the whole motor mechanism seems to be "going to pieces."

Warner[2] ascribes this want of precision, which is simply incoördination carried to a point where it becomes noticeable, to the spasmodic functioning of nerve cells in a condition of fatigue. The inhibitory processes are less effective; but inhibition is absolutely essential for fine, exact work of any considerable degree of com-

[1] It needs to be emphasized that to be "tired" is not of necessity to be fatigued. One may be tired or weary from sitting still, or listening to an uninteresting lecture, or waiting for some event to happen, but he may not be fatigued, for he may have a good stock of energy on hand to be expended in activity when the opportunity is presented. When one is fatigued it means that he has actually expended a large part of his available energy. Cf. MacDougall, *Psych. Rev*, March, 1899.

[2] "The Study of Children," pp. 52 *et seq.*

plexity.[1] The Hughlings-Jackson theory[2] accounts for the phenomenon here in question by hypothesizing that the coördinating areas in the brain are unable to act with accustomed authority, and movements result which are not so fully under the direction of the will.[3] But whatever the neurological explanation may be, it is enough for practical purposes to recognize that the exhaustion of nerve centers results in lessened power of exact and sustained coördination.

Fatigue produces tension. Again, many people when in a fatigued condition find that they become tense, rigid, constrained. Their lips become compressed, their fists clenched, and so on. And then they grow "restless" in order to release the tension. Nature teaches one to do this in order to relieve the strain on the central nervous system. When one's muscles are needlessly tense he is wasting energy that should be conserved. If I should keep my fists, say, tightly clenched for an hour, a good deal of energy would be drawn off from nervous centers.[4] It is highly important then that one should rid himself of useless tensions, and nature prompts him to do this more or less unconsciously. One may go into a certain type of schoolroom at half-past

[1] See Chaps. II and V of this volume.

[2] See Anderson, in Hack Tuke's "Dictionary of Psychological Medicine," Vol. I, pp. 440 *et seq.*, for a discussion of Hughlings-Jackson's theory, which seems now to be accepted by practically all physicians.

[3] Cf. Scripture, "The New Psychology," pp. 228 *et seq.*

[4] Cf. Woodworth, *Psych. Rev.*, Vol. IX, p. 183.

eleven in the morning, or thereabouts, after the children have been working for two or three hours, and find them moving about constantly, without any motive so far as one can tell. Every teacher must be familiar with this malady, the *bête noire* of many a schoolroom. I have known situations of this sort that have been remedied effectually by giving pupils a five-minute recess, or a half-hour for luncheon.

Leaky nervous systems.

Of course, people differ in their capacity to hold out against fatigue. Professor Bryan[1] has said that some persons possess leaky nervous systems, wherefrom energy flows away without issue in useful results. In such individuals activity will be likely to be in excess of that which the stimulus occasioning it should normally produce. Every one must have seen children, and adults as well, who when they hear a slight noise, for instance, which others do not mind, react out of all reason in jumping or screaming; or when spoken to unexpectedly their faces flush, their lips quiver,— in short they lose control of themselves in a measure. Such persons are unduly profligate in the expenditure of their means, and, in consequence, their capital is relatively soon exhausted.[2]

The writer recently conducted some experiments upon school children which yielded results that appear to confirm the view here set forth. Scripture's steadi-

[1] Add. and Proc. of the N. E. A., 1897, p. 279.

[2] Cf. Warner, "The Study of Children," Chaps. VIII–IX.

ness gauge was used in one test. This is designed to investigate stability of control by requiring a person to direct a light rod under guidance of the eye upon a point several feet distant, failure to accomplish this being announced by the ringing of an electric bell. The subject is usually required to make the trial fifteen times at a single test, and the number of successful attempts is taken to be, in a way, although it is not always reliable, an index to his power of motor control. But more important than the success or failure in accomplishing the task is the evidence it affords of the nervous condition of the subject as revealed in the by-product of his actions, so to speak. Tests were made in the morning, shortly following the opening of school, and again at half-past eleven o'clock, or thereabouts, after the pupils had been working over their lessons for about two hours.

One boy of eleven years, A. M., is a fair illustration of what might not inappropriately be called a wasteful type. In the morning tests he was well controlled and accurate. But a record of five tests made at half-past eleven all show that after four or five attempts to place the rod upon the point his hand became unsteady, his lips compressed, the region about his eyes showed tension, and the hand not being used was tightly clenched. Ten trials were usually sufficient to produce twitchings in the face and body, although nothing of this sort was noticed at other times. This boy invariably made hard

work of the midday task, and all the physical accompaniments indicated excessive motor stimulation following, apparently, upon an unduly active condition of nerve cells. At the close of the experiments he generally seemed exhausted, and upon three occasions it was thought best not to permit him to make the entire fifteen trials.

The thrifty type.

Another pupil, W. R., two years younger, illustrates a different type. In the morning trials he was no better than A. M., but he, too, was subjected to five different tests at half-past eleven, with the result that he could, in every instance, complete the test without any apparent fatigue. There was no constraint apparent in the face or hands, no unusual effort to coördinate the muscles of the body, and no twitchings of any kind. Now, it seems probable that in the case of W. R. the brain was able to adjust effort in right degree to the needs of the occasion, while with A. M. there was such prodigality in the expenditure of energy in various irrelevant motor tensions and activities that it was soon largely spent. A. M. showed this tendency to nervous extravagance in all the work of the school. While an unusually bright boy, he yet became fatigued in the performance of duties that W. R. could discharge with no evidence of overstrain.[1] Indeed, the latter boy seemed never to reach

[1] Since these tests were made I have had opportunity to observe two brothers who are good illustrations of the types described above. They are both in school; but one is intense in all he does — he is "high-strung,"

a point beyond which he could not go with safety if he chose.

A simple method of testing individual differences.

Further illustrations of this principle of individual differences in the conservation of nervous energy were afforded by another simple experiment. The apparatus employed consisted of a plate of smoked glass set in a frame so that it could be moved horizontally. Just touching the glass, and adjusted to it by a delicate spring, was a fine metal point which could be maintained at any height by a silk thread to be held in the fingers of the subject to be experimented upon, who stood with closed eyes endeavoring to keep his hand perfectly quiet for one-half a minute. During the test the glass was moved slowly in the frame, the metal point thus tracing a line which was an index of the steadiness of the subject's hand. Five sets of experiments were made upon a number of pupils in the morning soon after the opening of the school, and again just before the noon recess.

The accompanying tracings, Fig. 10, are reproductions of those gained at one of the tests, and are typical examples. The first two were secured from a girl, M. L. R., eleven years of age. The one made at half-past eleven, after two and a quarter hours' work in school, shows a significant phenomenon which could be easily witnessed

his teachers say, and he very often is in a nervous, uncontrolled condition before the day is over. His brother goes on from day to day doing his work without any apparent strain.

during the short period of the experiment. One could observe her arm and fingers contracting, which accounts for the upward direction of the tracing. The body swayed almost to the point of falling, the fingers of the hand not employed were clenched, and all her expressions

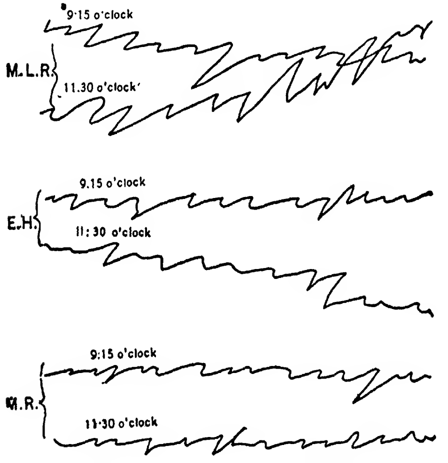

FIG. 10.—Tracings showing the different effects of mental labor upon pupils, as explained in the text.

indicated tension. The second set of tracings, gained from a girl, E. H., twelve years of age, shows evidences of fatigue after a few hours' work; but the effect upon the motor activities is quite in contrast with that of the case just mentioned. Here there was relaxation of the

muscles, a general letting down, revealed in the tracings taking an abrupt descent. The third group of tracings was gained from W. R., whose characteristics have already been alluded to, and who indicated here, as in other tests, that his morning's duties had had no serious effect upon his nervous condition.

The effect of fatigue on attention.

Thus far I have been speaking of the influence which fatigue exerts upon motor abilities. But the harm done here is probably not so great as that sustained by the mental faculties. To begin with, attention becomes less concentrated and enduring than when one is in good neural form, so to speak. Any person who has endeavored to apply himself to arduous tasks when his resources have been too heavily taxed, knows that it is with great difficulty he can hold his mind to the thing in hand, and he is likely to fail altogether in the attempt. As James has said,[1] one grasps at everything in order to find relief from the object before him. At this time there crowd into the mind irrelevant ideas, which in seasons of mental vigor one can keep out. And the upshot of the matter is that distraction ensues. The mind grows inaccurate, wandering here and there in an aimless way, and one finally reaches a stage of stupidity. In fatigue it is probable that the motor coördinations involved in attending to a given idea can be sustained but for a relatively short period, and when they begin to disintegrate another

[1] "Psychology: Briefer Course," p. 225.

system of coördinations comes to the front only to soon meet the fate of the first one, and so it goes.[1]

If, then, in fatigue attentive attitudes can be maintained but for relatively brief periods, it is not difficult to foresee the result on mental efficiency. A chaotic mind cannot exhibit keenness, readiness, or accuracy in any of its operations. We would expect, in the first place, that perception would be less discriminating, and this has been corroborated by extensive investigations upon the several senses.[2] The writer has tested this matter in the public schools, and the results are in accord with the general conclusions reached by Kraeplin, Bürgerstein, Ebbinghaus, and others, after more elaborate studies, to which reference has been made. Pupils were required upon three successive days, at half-past nine o'clock and again at half-past eleven in the morning, to trisect a line three inches long. The results show that on the average they were several millimeters nearer correct in the morning trisections than in those just before the midday recess. It seems that this test measured in a way the degree of attention which pupils were able to exert at different

[1] See, for an interesting discussion of the effect of fatigue on attention, Mosso, "Fatigue," Chap. VIII.

[2] See, for the results of some investigations: Gilbert, "Studies upon School Children in New Haven," in *Studies from the Yale Psych. Lab.*, Vol. II; Sinclair, "Schoolroom Fatigue," *Educational Foundations*, May and June, 1896; Dresslar, "Fatigue," *Ped. Sem.*, June, 1892, Vol. II, pp. 102–106; O'Shea, "When Character is Formed," *Pop. Sci. Mo.*, Sept., 1897.

hours during the day, and it confirms what one who observes the work of any pupil closely will be likely to see very frequently, — that six hours' work in school

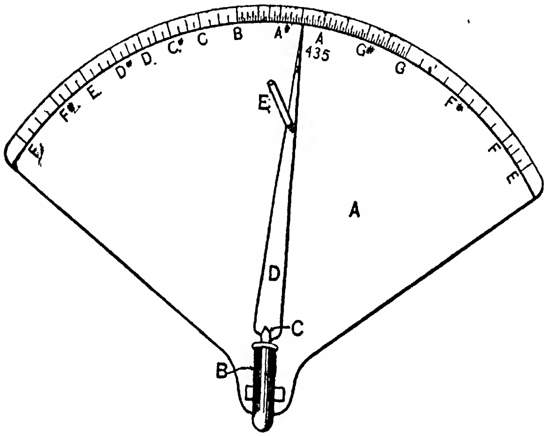

FIG. 11. — THE "TONE TESTER."

The fan-shaped plate *A* is supported by a handle beneath it. The pipe *B*, fastened to *A*, contains a vibrating reed whose length is regulated by a tightly sliding clamp, the projecting rod of which is shown at *C*. This clamp is moved by a lever whose long arm *D*, with the handle *E*, extends out over the plate. It is readily seen that, for each different position of the point of the long arm, the vibrating reed will have a different length, and the tone produced will be different in pitch. It is also evident that a small difference in pitch corresponds to a large movement of the point of the long arm. — GILBERT.

reduces the vigor of attention. Again, children were asked to sort colored yarns, to distinguish tones made by the tone tester (Fig. 11) and the same effect of fatigue

on attention was observed. Thoughtful teachers must notice that it is more of a task to hold the thoughts of students to the subject in hand at half-past eleven than at half-past nine; and if recitations in hard studies occur late in the forenoon, progress will be slow and frequent mistakes will be made, probably because pupils are unable to attend vigorously.[1]

One cause of dullness in the schoolroom and out side.

Now, if a pupil cannot coördinate himself fully upon a thing to be dealt with, his mental processes will all be affected unfavorably thereby. He will be unable to perceive accurately, or recall fully or speedily what has formerly been mastered; and, most serious of all, he will be unable to view complex objects or ideas in such detail as to discover their deeper relationships — that is, he will be deficient in reasoning power. In fatigue, then, one's mind loses its tone and its stability. Suppose a fatigued pupil in school working over his spelling lesson, for instance; he will be liable to make errors both in copying from the board and in reproducing what he already knows. In recitations in history, memory will be halting; what has apparently been made secure some time before may now be out of reach.[2] In those studies requiring reflection, as

[1] Cf. the following: Kotelmann, "School Hygiene," Chaps. VII, VIII; Shaw, "School Hygiene," Chap. XI; Külpe, "Outlines of Psychology," p. 43; Leuba, *Psych. Rev.*, Vol. VI, p. 573; Germann, *Psych. Rev.*, Vol. VI, p. 599.

[2] As Ribot says: "Fatigue in every shape is fatal to memory. The impressions received at such times are not fixed, and the reproduction of

arithmetic, grammar, geography, and the like, the reasoner will be unable to hold his thoughts continuously to the matters under consideration, and so will be unable to detect subtle connections.

One may frequently hear those about him say something like the following: "I derive much greater benefit from visiting an art gallery in the morning than at five o'clock in the afternoon;" or "I find more pleasure in going out into the fields and coming in contact with nature in the morning hours than later in the day, for I see more, or at least I appreciate more. Everything has a meaning for me now which is not so apparent at other times. There are details and harmonies in sound, color, and form which I apprehend when I am refreshed but which I miss when my mind is tired." And the rationale of this seems evident. It is not that there is less of beauty and richness in nature in the late hours of the day, nor that the visual or auditory sense organs are incapable of receiving stimulations therefrom, but it is due most largely to fatigue of the central nervous system, which disturbs the processes of interpretation of the stimuli that are received. Again, when we are fatigued we realize that we must defer the consideration of difficult matters until a more favorable period, when mental freshness has been regained. We

them is very laborious and often impossible. . . . When the normal conditions are restored memory comes back again." "Diseases of Memory," Chap. V. Cf. Mosso, *op. cit.*, p. 200.

attack our mathematical problems in the morning rather than at five o'clock in the afternoon. Even social custom has recognized this and has assigned the later hours of the day to occupations and pastimes requiring relatively little concentration.[1]

The effect of fatigue on the emotions.

Fatigue has a similar effect in principle upon the emotional as upon the motor and intellectual activities. Many people are aware of this, and they freely condone the bad temper of individuals at certain seasons because of their "tired" condition. It will surely impress one who has never thought of the matter to observe how, in a siege of neurasthenia, antisocial qualities, as irritability, jealousy, hatred, anger, and the like take possession of an individual who in better times is well poised and not too conscious of himself in relation to others about him.[2] I have for a number of years been making some notes on the daily lives of several children, and over and over again I find statements like this: "S. did not sleep well last night, and seems irritable and unhappy to-day;" "B. has played very hard all day, is fatigued to-night, and it is difficult to get on with him. He has lost his usual fine control and happy way with people"; "H. has not been quite herself

[1] Thorndike (*Psych. Rev.*, Vol. VII, p. 479) mentions the following as among the most prominent effects of fatigue,—slowness and inaccuracy of association, lack of inhibition, irrelevant ideas, mental confusion, impulses to stop work, purposive trains of thought interfered with by feelings of *ennui*.

[2] Cf. Mosso, *op. cit.*, p. 238.

the past week or so, — she is taking little food, and has been much excited. She is not pleased with the things which ordinarily give her pleasure, and she complains much and cries easily;" "H. is more irritable and uncontrolled when she plays with certain nervous children than when she is left alone, or plays with quieter children." And similar instances might be cited at any length.

It has already been pointed out that in a state of fatigue the nerve cells are unstable, giving off energy — exploding as it were — without sufficient cause.[1] A person who when refreshed and vigorous would be able to inhibit impulses to anger, or quick words, or passion of any sort, would probably in a state of fatigue lose this power, at least in a measure. That is, fatigue in most instances lessens one's inhibitory power and then he reacts upon stimuli without, as we say, deliberation or consideration. It is maintained, too, by Dresslar and others, that fatigue produces a melancholy, depressed feeling; causes one to turn his thoughts in upon himself, and to become morbid and gloomy if this self-consciousness is long continued. Further, it is the opinion of those who have had large experience with such matters that those qualities of character which are described by the terms "vicious" or "criminal" are due to perverted feelings dependent upon impaired

The benumbing of the highest faculties in fatigue.

[1] Compare Swift, "Sensibility to Pain," *Am. Journ. of Psych.*, Vol. XI, No. 3, April, 1900; and Reprint.

physical conditions, especially of the nervous system.[1] It has become a maxim that a man in a state of hunger is much harder to govern than when he is well nourished. "How many tempers," says Stanley Hall,[2] "have been spoiled simply by fatigue! It is hard to be good-natured when you are tired, and so very easy to be good-tempered when you are all in good condition." Untruthfulness, which Kant has called the negation of self, is generally a characteristic of an individual who has not vigor enough to face boldly the consequences of his acts. It would doubtless be within bounds to say that in general one who is physically weak, who is nervously depleted, is usually, although perhaps not always, morally weak.

Campbell,[3] in discussing the tendency for one afflicted with nervous disease of any kind to become the creature of egoistic emotions, makes a point which will be in place here. "We frequently find," he says, "emotions like fear and anger, which we have in common with the brutes, accompanying the slighter disorders of the nervous system. In this connection one calls to mind the condition of a hungry man jaded with a hard day's work; until refreshed by food and drink he is apt to be irritable, to break

[1] See Collin, Papers in *Penology*, 1891, pp. 27–28; also Wey, in same, pp. 57–69; Wright, *Am. Journ. of Neurology and Psychiatry*, Vols. II–III, pp. 135 *et seq.*

[2] *Primary Education*, Vol. XI, p. 216.

[3] "Differences in the Nervous Organization of Man and Woman," p. 301.

out wrathfully, and this irritability is no doubt related to the savageness of the hungry animal, a condition of mind often necessary to the successful struggle for food."

TOPICS FOR INVESTIGATION AND DISCUSSION

1. Many people believe that when a boy is lazy his will is lethargic, and it should be aroused by dermal stimulation. May there be a physiological cause of laziness?

2. Have you ever been so "fagged out" that you could hardly "drag yourself around"? Was the source of the difficulty, probably, in the muscles or in the nervous system? How can one tell where it was?

3. Children often come home from school, and feel utterly indisposed to engage in games or plays or work of any sort. They may throw themselves on a sofa, and remain inactive for hours at a time. What is probably the source of the difficulty in such cases?

4. When one starts up suddenly and vigorously any activity, as running, he is likely in due course to come almost to a halt; but if he keeps striving to continue he will probably find that his power will return gradually. Explain.

5. Do schoolroom errors, due to "carelessness," so-called, occur most frequently at certain times in the day or the week, or the year? If so, what is the explanation?

6. Ask pupils to reproduce, in as precise a manner as possible, a copy of considerable length and complexity at hour intervals during the day. Then study the reproductions with a magnifying glass, and note whether they grow more or less precise as the day progresses. What factors may produce any change you observe?

7. At what periods during the day are school children most restless? Why?

8. Describe simple methods, practicable in the schoolroom, of ascertaining individual differences in the matter of fatigue. How can you use this information to advantage when you obtain it?

9. Are there certain hours during the day when you find it relatively quite difficult to attend to your studies? Explain. What success do you have in mastering your tasks at such times?

10. Have you observed that people inclined to be irritable give way to their passions more especially at particular times during the day or week or year? What is the explanation?

CHAPTER XIV

ECONOMY IN THE EXPENDITURE OF ENERGY*

The loss of energy in a machine.

It is recognized in mechanics that a large part of the energy expended in the working of a machine is wasted; a relatively small amount, say 25 per cent, in the best machines is devoted to accomplishing the purposes for which the machine operates. The more perfectly a machine can be constructed, so as to save this waste, the more efficient it becomes, of course. Now, the human body is a sort of machine; it has work to accomplish and a given quota of energy which may be utilized for this purpose. If one should maintain that it has been so carefully fashioned that there can be no loss of vital force, that all parts run together so smoothly and coördinate so nicely that there is no leakage anywhere, he would doubtless have a show of reason on his side. It would be a fortunate arrangement if this most intricate of all mechanisms could run of itself, without superintending, and without unnecessary outlay of energy. But it is probable that with the majority of us, on account of wasteful habits contracted in one way and another, there is dissipation of force by friction, which can be reduced at least by a little deliberate planning.

One of the most important sources of waste is found in muscular tensions which are not at all essential to the accomplishment of the piece of work in hand. The truth of this will be apparent when it is remembered that the exercise of a muscle involves stimulation from nerve centers. This stimulation implies a drain upon nerve cells, — useless expenditure of energy, that is to say. When any task, as writing, is to be undertaken, then, economy requires that if possible no muscles be active except such as are necessary to the execution of the task, or that furnish an outlet for excess energy, and it should be said that there is probably always some of this, at least when one is learning any new art. But take this case, a very common one: An adult sits down to write a letter; he takes his pen in his right hand, but the left hand becomes clenched, the lips compressed, deep furrows crease the forehead, and the fingers grasp the pen with excessive force. In such a case a considerable amount of energy is being expended without profit. The unnecessary tensions are draining the organism of force that should be conserved.

Loss in the human machine from muscular tensions.

It may, perhaps, be regarded as a commonplace to say that there are practices in school life, as in the life outside, which result in squandering energy, and which can probably be corrected without inducing too great self-consciousness. In the first place, mental tension readily begets muscular tension. When one is troubled in spirit;

Mental tension begets muscular tension.

when he discerns obstacles ahead that seem insuperable; when conscience is incessantly active, censuring one for past deeds and exhorting him to be especially careful in the future; when life seems full of cares that demand unceasing attention, — such a condition of mind produces all sorts of tensions and constraints which sap the organism of its vitalities. When the attention is centered upon dangers ahead, the body unconsciously takes on an attitude of defense, as it were; or, to be more precise, the organism seeks to adapt itself to any situation pictured in imagination, as we say, and when we see an enemy crossing our path we make ready to annihilate him, or to betake ourselves out of his reach.

One may see on the street every day, people with rigid countenances,—deep lines between the eyes, strain about the mouth, the body tense, inflexible. When you talk with such persons you can observe "nerve signs" in all the sensitive muscles of face, hands, and body generally. These are the people who are continually drawing too heavily upon their nerve accounts. Their outlay commonly exceeds their income; or at least there is never any large balance on the credit side of the account. Pupils sometimes sit in their seats in the schoolroom afraid of a savage teacher, and every moment their vital forces are being wasted. Or they may be filled with fear in the presence of some of their schoolmates or even of a parent; but no matter what may be the cause of dread

the result must prove disastrous. Whatever other sins you may commit, Mr. Pedagogue, do not add to the already heavy burdens of a timid pupil.

The hypochondriac. There is a class of what might be called overconscientious individuals. They can never do anything without worrying about it before and afterwards. They are troubled lest they have not done or will not do just the right thing on all occasions. They belong to what Ribot would call the egoistic-introspective type; they cannot get away from themselves, and hence are constrained and tense in most of their activities. It seems to be a law of our human nature that turning the mind in upon self much throws the machinery of life out of gear. Too much reviewing of conscience, too much hunting after one's faults, ends in conscience being a very ineffective guide in life. Its mandates cannot be carried into effect by aweakened organism.

Americanitis. So much has been said in recent years about "Americanitis" that it may be mentioned in this connection. It is maintained by those who ought to know whereof they speak that our American people do not understand how to rest effectually; which means, as construed by some, that they make a great deal more fuss than is necessary about doing a thing. Their efforts are considerably in excess of that which particular occasions demand. When they undertake tasks that should employ the hands only they use the whole motor apparatus. They scowl and grit

their teeth and stiffen their knees, and in other ways let go of energy they can ill afford to lose in this way. Dr. Clouston, the eminent Scotch authority upon nervous diseases, visited our country some time ago and is reported by James to have said: "You Americans wear too much expression upon your faces. You are living like an army with all its reserves engaged in action. The duller countenances of the British population betoken a better scheme of life. They suggest stores of reserved nervous force to fall back upon, if any occasion should arise that requires it. This excitability, this presence at all times of power not used, I regard as the greatest safeguard of our English people. The other thing in you gives me a sense of insecurity, and you ought somehow to tone yourselves down. You really do carry too much expression, you take too intensely the trivial moments of life."

Adjusting effort to needs. It is a vitally important matter in every one's life, and especially in the early years when habits of economy or dissoluteness are being established, to get into the way of adjusting effort to the task to be accomplished. When great undertakings are to be handled our forces must all be summoned for action; but it is nothing less than profligacy to expend as much on trifling as on momentous occasions. But how can one release these wasteful tensions? Manifestly the first requisite is to change the mental attitudes which produce them. And first, one who keeps his shortcomings constantly before his mind's eye

pursues a very good course to dissipate his forces, for he cannot be looking inward all the time, inspecting his limitations and errors, without inducing strain and stress of mind and body. As Professor James says, the "melancholic patient is filled through and through with painful emotions about himself. He is threatened; he is guilty; he is doomed; he is annihilated; he is lost. His mind is fixed as if in a cramp on this sense of his own situation." [1] And unfortunately, the more one thinks of his failings the more securely do they fasten themselves upon him. He rises above his lower self mainly by filling his mind with ideals outside of himself, so that he may grow up towards them. This is the only way, too, in which the machinery of life can be got to run smoothly; which fact is evidenced constantly among the people we meet in daily life.

One sees now and again a person who lives an outward life. His mind is not upon himself much of the time; he does not question unendingly whether what he does is just right and proper, whether he ought not to have done something else; whether other people's actions are intended to injure him, and so on. His mind is full of interesting and worthy ends to be attained. Then, if we observe his reactions upon the world, we shall find that there is no scowling except when there is occasion for it; no rigidity of features, no constraint and formality of bearing. Rather he is free and unconstrained in all his

[1] *Scribner's Magazine*, April, 1899, p. 505.

activities; the delicate mechanisms of his being work together harmoniously, and but little energy is expended except for the accomplishment of definite work. Much egoistic-introspective thinking seems to irritate the nervous system, unloosing forces which should be securely held until they can be profitably utilized.

James on "unclamping."

I can do no better here, I think, than to quote Professor James's advice[1] to those persons who are continually thinking about themselves: "If we wish our trains of ideation and volition to be copious and varied and effective," he says, "we must form the habit of freeing them from the inhibitive influence of egoistic preoccupation about their results. Such a habit, like other habits, can be formed. Prudence and duty and self-guard, emotions of inhibition and emotions of anxiety, have, of course, a needful part to play in our lives. But confine them as far as possible to the occasions when you are making your general resolutions and deciding on your plans of campaign, and keep them out of the details. When once a decision is reached and execution is the order of the day, dismiss absolutely all responsibility and care about the outcome. *Unclamp*, in a word, your intellectual and practical machinery and let it run free, and the service it will do you will be twice as good. Who are the scholars who get 'rattled' in the recitation-room? Those who think of the possibilities of failure and feel the great importance

[1] *Loc. cit.*

of the act. Who are those who do recite well? Often those who are most indifferent. *Their* ideas reel themselves out of their memory of their own accord. Why do we hear the complaint so often that social life in New England is either less rich and expressive or more fatiguing than it is in some other parts of the world? To what is the fact, if fact it be, due, unless to the overactive conscience of the people, afraid of their saying something too trivial and obvious, or something insincere, or something unworthy of one's interlocutor, or something in some way or other not adequate to the occasion? How can conversation possibly steer itself through such a sea of responsibilities and inhibitions as this? On the other hand, conversation does flourish and society is refreshing, and neither dull, on the one hand, nor exhausting from its effort on the other, wherever people forget their scruples and take the brakes off their hearts and let their tongues wag as automatically and irresponsibly as they will."

The reflex effect of bodily attitudes.

While economical bodily attitudes and activities are generally insured by mental poise and wholesomeness, still something may be accomplished on the motor side by deliberately striving to let go of one's self occasionally. There is a good bit of sense in the Delsartean philosophy, which holds, first, that the most efficient individuals in intellect and character are those who are freest and most unconstrained in peripheral activities; and, second, that

by proper exercise we may cultivate the power of "holding centers firm and releasing extremities." The Delsartean physical culture really helps "bottled lightning" people to take themselves less seriously. There are so many persons, who, even when they rest, as they say, sit with clenched fists and rigid body, thus encouraging incessant drain on the nervous system. Let one who is conscious of unnecessary tenseness in his muscles voluntarily relax at certain times of the day as a matter of discipline. This will assist in relieving his nervous system; and in time he will find himself relaxing unconsciously, which James considers to be an imperative duty for the majority of American people. He will find, when he does this, that his mental brier-patch will not seem quite so thorny; he will occupy a less prominent place in his own reflections. For as ideas and feelings find their way into motor actions, so motor attitudes influence the current of one's thought and feeling. Deliberately assume any given attitude and it will tend to awaken the emotion which usually initiates this attitude. Take on the outward manifestation of fear and fear is easily engendered; while if one stands bravely against the world, courage will be strengthened.[2] The sensory, central, and motor

[1] Any teacher would be aided personally and professionally, I think, by reading Annie Payson Call's "Power through Repose." See also an article by the writer in the *Atlantic Monthly*, February, 1895, pp. 246–254.

[2] In the words of Ribot: "It is less generally known that movements and attitudes of the body, artificially produced, are capable (in some

processes constituting any act are really a unity; they are phases of a whole. When S (Fig. 10) is acted upon by something in the world without, certain correlated ideas and emotions will appear in C, and these will set off correlated responses in M, which will bring the individual into desired adaptive relations with the object acting at S. And now, if we deliberately reinstate certain attitudes in M, we are likely to awaken the ideas and feelings ordinarily connected therewith; so that one who consciously puts himself into postures of repose and control may make a beginning in securing mental quietude.

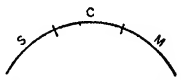

FIG. 12.—Schema to illustrate interdependence of sensory, mental, and motor processes in all activity.

S—Sensory System.
C—Central System.
M—Motor System.

Play as a restorative.

It seems to be a principle of our human nature that what we like to do is in general better for us than the things we hate. Pleasurable activities create less wear

cases, and to a slighter degree) of exciting the corresponding emotions. Remain for some time in an attitude of sadness, and you will feel sad. By mingling in cheerful society and regulating your outward behavior in accordance with it, you may awaken in yourself a transient gayety. If the arm of a hypnotized subject is placed, with clinched fist, in a threatening attitude, the corresponding impression spontaneously appears in the face and in the rest of the body; the same holds good for the expressions of love, prayer, contempt, etc. Here the movement is the cause and the emotion the effect. The two cases are reducible to a single formula. There is an indissoluble association between a given movement and a given feeling."—"The Psychology of the Emotions," p. 392.

and tear than those which are distasteful,[1] an arrangement we should infer from the principles of evolution, even if we had no confirmatory experience with it in our own lives. Disagreeable tasks lie along the lines of greatest resistance for the organism, so a relatively larger amount of energy must be expended in overcoming them; while on the other hand, what is agreeable runs along ways of easy progress, and makes comparatively little demand upon our powers.

This doctrine is of vital consequence in relation to our physical exercise. Games and plays and gymnastics which are pleasurable will accomplish the purpose of recreation better than those which are indifferent or boresome.[2] A game which will enlist our lively interest will do much more for us than formal drill which we have

[1] Compare the following from Galton: "We must be on our guard against estimating a man's energy too strictly by the work he accomplishes, because it makes great difference whether he loves his work or not. A man with no interest is rapidly fagged. Prisoners are well nourished and cared for, but they cannot perform the task of an ill-fed and ill-housed laborer. Whenever they are forced to do more than their usual small amount, they show all the symptoms of being overtasked, and sicken. An army in retreat suffers in every way, while one in the advance, being full of hope, may perform prodigious feats." — "English Men of Science, their Nature and Nurture," p. 75.

[2] From the earliest times men have appreciated the transcendent value of play in the development of childhood and youth. See, for instance, Plato, "Laws," I, 643, and "Republic," VIII, 537; Aristotle, "Politics," Bk. VII, 17; Froebel, "Education of Man," Sec. 30; Locke in Quick's "Locke on Education," pp. 55, 76.

to coerce ourselves through. In other words, play, in the best sense of the term, whether in the gymnasium or out of doors, constitutes by all odds the most efficient method of exercise. It usually involves the various organs of the body and utilizes highly coördinated and complex activities, so that all parts of the motor mechanism of the brain are brought into action. "Man is wholly man only when he plays," Schiller says. On the other hand, formal drill ofttimes makes use of only a few movements and so stimulates but small portions of the cerebral motor areas.[1]

Exercise should not require voluntary effort.

Again, so far as possible, the will should be released in physical exercise. This is accomplished more largely in play than in drill which a pupil dislikes, as in marching or anything of the kind. Things which we hate we have to exert ourselves to overcome, but it is altogether different with those activities which draw us spontaneously. Observe a boy at play and at work. The play may really be harder, in the sense that more work is done and more

[1] Cf. the following: O'Shea, "Physical Culture in the Public Schools," *Atlantic Monthly*, February, 1895; Groos, "The Play of Man," Parts I, II; Hughes, "Educational Value of Play, and the Recent Play Movement in Germany," *Ed. Rev.*, Vol. XIII, pp. 327 *et seq.;* G. E. Johnson, "Education by Plays and Games," *Ped. Sem.*, Vol. III, pp. 97–133; Earl of Meath, "Public Playgrounds for Children," *Nineteenth Century*, Vol. XXXIV, pp. 267 *et seq.;* Gulick, "Psychological, Pedagogical, and Religious Aspects of Group Games," *Ped. Sem.*, Vol. XI, No. 2; and "Some Psychical Aspects of Muscular Exercises," *Pop. Sci. Mo.*, Vol. LIII, pp. 793–805.

difficult movements are performed, but yet his will is not exerting itself against obstacles and so he is really less fatigued over the heavier than the lighter task. And so it is with all of us; we tire much more readily in performing tasks in which we have no interest. Economy and efficiency then demand that a pupil's physical exercises be genuinely pleasurable; that he go to them without having to drive himself. Recreation will in such a case accomplish the purpose for which it is taken, rather than become an additional burden to an already overtaxed will. In order that recreation re-create it must refresh and not overtax; it must leave the individual with more power and spirit than he had when he began.

Exercise for brain workers. Pupils and brain workers of every kind will probably be benefited more by activities requiring the greater use of the fundamental than the peripheral muscles. Gymnastics and games, then, should not require too exact and delicate coördinations, since it would seem that the school really demands enough of this sort of thing in the prosecution of the regular studies. The cerebral areas controlling the peripheral muscles are probably more largely involved in thinking, and it is desirable that our recreation should relieve these while calling others into play.

Again, it seems to me especially desirable that a pupil's or teacher's amusements should engage the muscles principally, rather than the mind. Cards, checkers,

chess, and the like must be poorly suited to the needs of those who use their brains constantly in their regular employments. Whist exercises the brain only, and the same is true of checkers, and most card games. A pupil's life economically planned would be so ordered that he would expend in study all of the energies which should be devoted to intellectual activities, while reaction would involve motor processes almost wholly. Pastimes, whether in- or out-of-doors, that make the muscular element prominent are to be commended above those which involve sitting still and using one's head.

The importance of nutrition.

The discussion of this topic would not be complete without a word on the subject of nutrition. It seems a safe inference from the evidence everywhere at hand that the amount of energy which can be expended in mental and physical activity will be determined by the ease with which this may be obtained in the process of nutrition. It is a fact of daily experience that when the stomach is overloaded with indigestible and waste materials the mind becomes lethargic, and the body little disposed to vigorous activity.[1] Let any one recall his mental and bodily status after assisting at the ordinary Thanksgiving feast, or perhaps even the familiar Sunday dinner. At such a

[1] "But Christmas puddings, brawn, and abundance of spirituous liquors, throwing the mental originality into the channels of nightmare, are great preservations against a dangerous spontaneity of waking thought." — George Eliot, in "Silas Marner."

time the mind works slowly and inaccurately; and the philosophy of the thing is not at all abstruse. When food is taken into the system the organism will, if necessary, turn its forces wholly to extracting the nutriment contained therein. Suppose then that a considerable amount of half-raw starch, in breads or cereals or cakes, and fried meat and the like, finds its way to the stomach. The blood, rushing to the appropriate organs to supply the required digestive agents, must, of course, be withdrawn from the service of the cerebral and muscular systems.[1] When, on the contrary, food is eaten which is nearly ready for assimilation the organism can, while attending to the now easy labor of digestion, engage also, in a measure, in mental or physical work. It is a question regarding the part of his organism — head or stomach — that one wishes to have occupy chief place in his existence.

Dullness and irritability due to underfeeding.

That imperfect nutrition is the cause of much irritability, ugliness, viciousness, and kindred abnormalities in childhood is a matter of common observation. The following case is typical of many others which the writer has observed: H. was a well-developed child at birth, and everything went finely with her during her first five months. Throughout this period she slept well, and was happy and contented. She rarely protested against the established order of things. After the fifth

[1] Cf. Hutchinson, "Food and Dietetics," pp. 42–43. See also Williams, "The Chemistry of Cooking."

month, however, a change seemed to come over her. She became restless in her sleep; her features indicated that she was not happy or contented, and by the sixth month she could be called an irritable and peevish child. Some member of the family was now kept busy much of the time endeavoring to soothe her troubled spirit. This state of affairs continued until about the eighth month, when it was decided to make a change in her diet. Within a week it was observed that there was a marked improvement in her temper. After two weeks of the new regimen she had regained her former restfulness, sleeping peacefully a due portion of time; and gradually the expressions of irritability and moodiness disappeared. Her face would now light up as formerly with pleasant smiles whenever any one she knew was about, and once more she appeared to every one as a very good-feeling, happy child. From that time on care was taken with her food and her intellectual and emotional development was satisfactory in every way. Some time after her diet was enriched it was learned definitely that the food she had been getting just previously was quite deficient in nutritive elements.

The nutrition of school children.

Before leaving this topic of nutrition a word on the needs of school children may be in order. There is a movement on foot now in some parts of the country to establish lunch counters in public schools, where pupils may obtain refreshments at slight expense. The move-

ment has not thus far gained the headway it should because of the criticism of some people, to the effect that the school is an institution for training the head and not for filling the stomach. But the fact that confectionery stores always thrive in the neighborhood of public schools, in cities where there are no lunch counters, is evidence that children need some refreshment in the course of the school day, and they will provide themselves with innutritious, harmful stuff if the school authorities do not take the matter in hand and supply the want. In these days, when so much has been accomplished in the study of foods, relating to their nutritive value and the method of preparing them so that they will be palatable and easily digested, it is a misfortune that children should be compelled to get their nutrition from candy stores. Is it too much to say that a community is not expending its money profitably in the education of a poorly nourished child? If it is the function of society to educate the young, is it not its *duty* to make conditions most favorable for the attainment of the ends of instruction? This does not mean that school boards should feed school children gratuitously; but it does mean that it should provide the right sort of food at cost wherever there is need of it and the plan is at all feasible.

The question of the nutrition of country school pupils is even more important than that of city children, but many regard any improvement here as impracticable for

the present. However, a recent writer, a country school teacher, does not feel this way about the matter. She realizes the need of providing more wholesome and nutritious food for country children, and she has in her own school devised a way of meeting the need. If her suggestions could be carried into effect they would probably solve some problems that perplex every rural school teacher. There would be fewer dullards sitting on her benches, and the uncontrollable restlessness which takes possession of the average country school in the afternoon would be likely to receive an effective antidote. This is the way this Michigan teacher looks at the matter: "Oh, that dinner pail! Who does not know it? With its tempting and nutritious array of pie, cake, pickles and tarts, or worse, its yellow 'sody biscuits, dried apple sass and fried fat pork.' Yes, cold, greasy, fat pork! Then think of a child who walks from half a mile to two miles to school, rain or shine, snow or sleet, and who is expected to apply himself to the industrious pursuit of knowledge, living on such cold dinners during eight or ten months of the year!

"There are, to be sure, many broad-minded whole-souled farmers' wives (may their tribe increase) who do contrive to prepare, instead of knickknacks, something both palatable and nutritious for the noon-day luncheon; but the most intelligent care cannot make a cold meal as good as a warm dinner. And what is to prevent having

a warm dinner, or at least one or two warm dishes prepared in every schoolroom where there is a stove? A very little trouble and expense would furnish every district with the necessary cooking utensils, and the work of preparing the dinner and washing the few dishes used could, in most instances, be done by the pupils, who, with a little tactful guidance by a sensible teacher, would consider it a privilege to assist in the housekeeping."

TOPICS FOR INVESTIGATION AND DISCUSSION

1. Try the following simple experiments, noting how long you can continue in each case, and the general effect: (*a*) knit your brow, as in scowling or frowning intensely; (*b*) "double-up" your fist "with all your might and main"; (*c*) take a needle between the thumb and forefinger, and squeeze it as hard as you possibly can; (*d*) pull yourself by your arms as high as your chin, and remain there. Discuss the principle which these experiments illustrate.

2. Describe the "nerve-signs" (if you do not understand this term fully see Warner, *op. cit.*) which indicate undue strain in the case of a pupil in the schoolroom.

3. Show in as great detail as possible how fatigue is manifested in the people about you.

4. Study the people you know who exhibit bad "nerve-signs," and see if you can tell what has been the principal factor in causing their fatigue. Do the same with yourself.

5. Make out a list of the ways in which you think people in general and pupils in particular waste their energies.

6. Observe the people about you who seem always to have

an abundance of energy for any tasks to be performed. Are they on the whole less or more active than persons who are in a depleted condition? What is the secret of their keeping a good stock of energy on hand?

7. Do men who enjoy their work ordinarily suffer from nervous prostration? Compare them in this respect with men who regard their work as drudgery. Discuss the principle involved as it relates to the school.

8. From the standpoint of fatigue, say whether the following is a sound proposition: "Every man, woman, and child should mix in some play with his work every day of his life."

9. Show how the organism may waste its vitality in its efforts to extract energy from the food one eats.

10. Discuss the plan adopted in some cities of beginning school at 8.45 A.M., and going on without intermission until 1.00 P.M.

CHAPTER XV

THE EFFECT OF ÆSTHETIC INFLUENCES UPON MENTAL TENSION

The fatigued teacher.

TEACHERS are said to be rather more rigid and tense than most other people. And this, if true, is particularly unfortunate, since these disorders are contagious. If you are in a bad state of nerves, and show it in tensions in features and voice and bearing; if you are fussy and explosive, and I keep your company, I am apt to copy your expressions, and this has a tendency to lead me into your neurotic condition. Some of us instinctively avoid "bottled lightning" people, these nervous hypochondriacs, for they overstimulate us, and we realize it. On the other hand, we like to associate with well-poised and well-nerved persons, for they help us to keep ourselves in hand. "If you . . . achieve calmness and harmony in your own person, you may depend upon it that a wave of imitation will spread from you, as surely as the circles spread outward when a stone is dropped into a lake." [1]

For the teacher whose work tends to develop over-tension, there is one practical remedy, — he must fill his life with inspiring, cheer-giving ideas and influences,

[1] Professor James, *op. cit.*

which will dislodge the anxieties that tend to fasten on the brain like vampires, and suck out its vitality. A teacher, more than any other person, ought to have at hand constantly some great book that has lived long in the race because of the good it has achieved in giving men hope and courage, and banishing dread and worry. Then music hath charms for the teacher as well as for his pupils. Every one must have observed how quickly a strain of music will change the current of one's thought and feeling. It can make one sad or glad in a moment.[1] Edwards has presented us with a mass of evidence [2] showing that music may be used to soothe the troubled spirits of those whose fears and worries have carried them beyond the power of self-control. Dr. Samuel B. Lyon, Medical Superintendent of the Bloomingdale Asylum at White Plains, N.Y., gives expression to views that are corroborated by many others in similar positions. "So many different means are used in hospitals for the insane," he says, "to interest and divert patients, and to substitute healthy for morbid ideas, that it is hard to assign the relative value to each one. That we value the effect of music on our patients is evident from the fact that we maintain

Music hath charms.

[1] The following articles may be read with interest by any teacher: "Utility of Music," *Forum*, Vol. XXV, p. 300; "Music as Medicine," *Music*, Vol. XV, p. 651; "Effect of Music on Wild Animals," *American Naturalist*, Vol. XXXI, p. 460; "Cerebral Circulation and Music," *Music*, Vol. II, p. 232.

[2] See his "God and Music."

an orchestra of eight or ten pieces, composed of our medical attendants, and also that we have distributed a number of pianos about the house. We have regular musical entertainments at frequent intervals, and we encourage patients who have musical talent, or who have cultivated the art in the past, to take it up while they are with us. We can all appreciate, from our own experience, the cheering and soothing effects of certain kinds of music, and no doubt the same influences are exerted upon persons whose minds are abnormally excited or depressed."

Dr. Draper, an Irish alienist, says of music, in its influence upon those mentally troubled, that, "Nothing cheers these patients, or helps them forget their troubles in an equal degree to music. It transports them to another region for the time being, removes the cloud of depression, assuages grief, tranquillizes excitement, and rarely, if ever, produces the slightest ill effect. The position of music in the treatment of the insane is, and ought to be, a high one, and its importance can hardly be exaggerated."[1]

A teacher might use music much more than is usually done to subdue the disorder in a schoolroom which comes from fatigue. Admonition will often accomplish but little; scolding will only aggravate the difficulty; but the right kind of music, the kind that Plato would make so prominent,[2] — that which cheers and is the expression

[1] Quoted by Edwards, *op. cit.*, p. 168. See, in this connection, Haweis, "Music and Morals."

[2] See his "Laws," Bk. II.

of courage,— such music will help to restore the equipoise in overtense children. Shakespeare understood how profoundly music acts upon an individual. In the "Merchant of Venice" he says: —

"For do but note the wild and wanton herd,
Or race of youthful and unhandled colts,
Fetching mad bounds, bellowing and neighing loud,
Which is the hot condition of their blood;
If they but hear perchance a trumpet sound,
Or any air of music touch their ears,
You shall perceive them make a mutual stand,
Their savage eyes turn'd to a modest gaze,
By the sweet power of music: therefore the poet
Did but feign that Orpheus drew trees, stones, and floods,
Since nought so stockish, hard and full of rage,
But music for the time doth change his nature.
The man that hath no music in himself,
Nor is not moved by concord of sweet sounds,
Is fit for treason, stratagems, and spoils;
The motions of his spirit are dull as night,
And his affections dark as Erebus:
Let no such man be trusted. Mark the Music."

So in the words of Addison: —

"Music can noble hints impart,
Engender fury, kindle love,
With unexpected eloquence can move
And manage all the man with secret art." [1]

[1] "It is related that 'when bloodthirsty crowds could not be quelled by John Wesley's coal-black eye, nor by Whitefield's imperial voice, they

The pain and pleasure effects of every experience.

Modern biological psychology conceives of a human being as most delicately responsive, alike in a mental and in an organic way, to every aspect of his environment. All of his experiences, even to the very least and inconsequential, affect him for better or for worse. Every force that plays upon him, be it ever so slight, probably heightens the tide of life, or depresses it. Regarded from this standpoint, the sole concern of an individual is to keep in contact with those forces that confer greater strength upon him, that build up his organism, and avoid those that tend toward destruction. And pleasure and pain are the means by which one distinguishes between the beneficial and the detrimental forces acting upon him. Those that yield pleasure are on the whole salutary; those that yield pain are on the whole harmful; and for survival it is essential that one's pleasures should be kept more abundant than his pains. Pleasure results from a condition of congruity, and pain of incongruity, between the organism and its environment.

were known to slink and turn away when the truth was sung at them in Charles Wesley's hymns. Their ringleaders more than once broke down under them in tears and groans of remorse. They took the preacher by the hand, and went his way with him, arm in arm, swearing by all that is holy that not a hair of his head should be touched.' The part which gospel lyrics have had in subduing the half-wild animal natures of American pioneer settlers, slum dwellers, and Belleville *auvriers* is well known. Missionary work in all quarters of the globe would lose one of its most pervasive and persuasive forces if Christian propaganda were musically dumb." — EDWARDS, *op. cit.*, pp. 158–159.

How different forms affect us.

One phase of the environment which exerts a marked influence upon the organism is form, pure and simple. Experimental science has gone a little way in the analysis of this influence; and we have learned enough, it seems, to be able to say that the forms which we call beautiful are such because of the agreeable responses which they set up in the organism; while those which are ugly are so because they incite detrimental responses. The psychologist says we apprehend any form by exploiting it in a given manner. When I look at a human face, my vision is first directed upon some characteristic point, perhaps the eye; then it moves to other prominent points until it sweeps around the face as a whole. If this movement in exploitation is facile, easy, and, as Spencer would say, economical, the object under examination will, unless some associations operate to the contrary, be regarded as agreeable, so far as the form alone is concerned. If, on the other hand, there is unusual effort required in exploiting the object, or if ocular processes are necessitated which are incongruous, or if the work of exploitation is wasteful of energy, the object will appear to be more or less disagreeable.

Professor Witmer has treated this subject very satisfactorily in his "Analytical Psychology," and it may aid in making my point clear if I reproduce a few of his figures. In perceiving the form in Fig. 13, the eyes start at the left and sweep along over the line to the right. Most persons

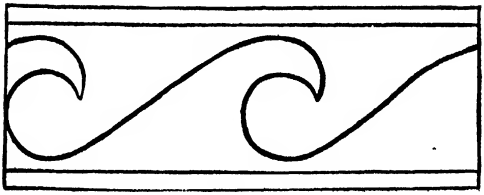

Fig. 13.

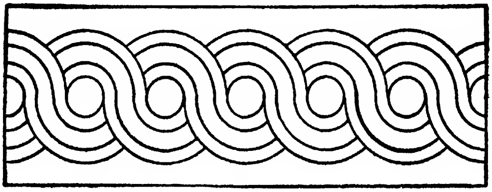

Fig. 14.

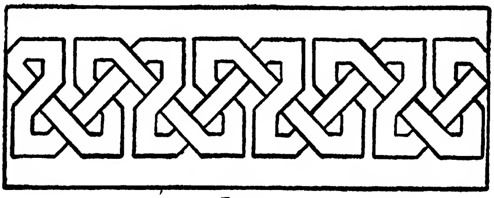

Fig. 15.

find the sensations involved in this process of exploitation quite agreeable. In Fig. 14 the ocular movements are more complicated, less regular and, perhaps one might say, *rhythmical*, and for many this is not so agreeable a form as the first, though for others the effort in exploitation will be enjoyed. As one looks at this figure, he finds

Note. — Figures 13, 14, 15, 16, 17, 18, and 19 are from Witmer's "Analytical Psychology." Copyright by Ginn & Company.

his eyes are incessantly striving to follow one group of lines in one direction, but are constantly drawn on to another grouping, coursing in a different direction, and this leads to confusion and actual pain with some persons.

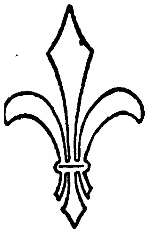

FIG. 16.

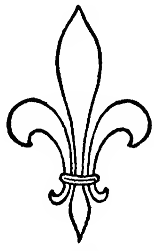

FIG. 17.

FIG. 18.

In the exploitation of Fig. 15, one has experiences similar to those gained with Fig. 14. In Figs. 16, 17, and 18, exploitation proceeds from near the base, in each case, upward and outward in the direction of the significant

lines. Probably most people enjoy Fig. 17 more than they do Fig. 16, because exploitation of curved lines is more agreeable than angular ones. In Fig. 19 there is a rotary exploitation, from left to right, and most people find the figure quite agreeable. These simple illustrations are designed to show that in apprehending any pure form,

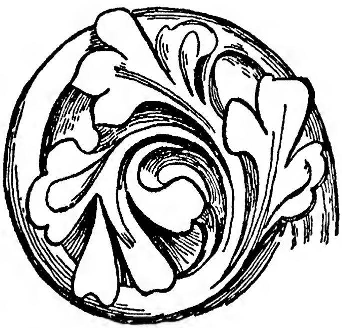

FIG. 19.

the ocular experience in exploiting it will largely determine whether it will be agreeable or otherwise.

Again, different complex forms influence one in different ways, through the sympathetic response of vital processes. Holmes has said somewhere that when one emerges suddenly from a wood, where his vision has been narrowly limited, into the open where the scene spreads broadly in every direction, his whole being will respond appropriately. In his own organism he simulates the things he looks

upon. Vernon Lee, in some interesting studies relating to our reactions upon the forms in our environment, calls attention to the fact that when one stands under the great dome of St. Peter's, his whole being expands in emulation of what he looks upon. Groos[1] has dwelt at length upon the tendency of one to put himself *en rapport* with the thing which engages his attention, and while this is especially true of our experience with human beings, it is by no means confined to these experiences alone. When I behold a building, the parts of which are well poised, and in which there are graceful curves, I have within myself the feeling of freedom, of movement, but also of poise and strength and balance. Little as I may be aware of it, my whole being is active in adjustment to anything which claims my attention. If I come into a room and see the pillars aslant, and everything out of poise, I am distressed. Most persons cannot endure such an experience; and it is not only the spirit, in the narrow sense, that is affected, but the disaffection strikes into our very vitals. Thus one moves about in the world, responding more or less to all the forms he looks upon, and he classifies them as beautiful or ugly, according as they stimulate agreeable or disagreeable responses in him.

Again, color exerts a mighty though silent influence upon the human organism,[2] in some cases beneficially,

[1] See his "The Play of Man."

[2] Color exerts an influence upon even the lower forms of life, as is shown in the manner bees, butterflies, moths, and birds are affected by

The influence of color.

and in others detrimentally. It is shown in the psychological laboratory that color, most often red perhaps, may cause the heart to beat more quickly, increase muscular effort, and deepen respiration; while a different color, as gray, may have a subduing influence upon these vital processes. We all realize that some colors stimulate us strongly; they excite us too greatly, it may be, and we dislike them; we say we cannot tolerate them. Others do not stimulate us enough, and we say they are cold, lifeless, indifferent. Still others afford us just the degree of stimulation we need, and these we regard as agreeable, or beautiful. These latter attract us; we strive to go where we can see them, and if we can we surround ourselves with them.

It is not implied, of course, that any given color will always affect us in precisely the same way. When one is already tense and overwrought, when his nerves are unstrung, he may feel the need of quiet colors, those which will not excite, but soothe rather. But when he is full of health and needing action, he may be delighted with stimulating color as he is with stimulating music; he has energy to expend, and the stimulations that will call it forth are regarded as agreeable. Different people, too, are affected differently by any given color, depending

brightly colored flowers. The bright plumage of birds has been selected because of its advantage in mating. Very young children choose colored objects and pictures before mere black and white.

doubtless upon nervous tone. Still again, the effect of color stimulations is different at different periods in one's life. The child may enjoy the vigorous stimulations of strong color, while the sensitive adult may be unduly excited by it, and seek something quieter. But, speaking practically, he cannot impose his likes upon the child; the latter may be left wholly uninfluenced by stimulations, which are just sufficient for the adult. Studies by Mrs. Hicks, Barnes, and others show that young children are most pleased with yellow and orange, but in maturity these are said to be too "gay" and "gaudy" and "flashy." If we arrange, as some experimenters of late have done, the color choices of children from three to twenty, there will on the whole be a continual softening in tone with increase in years.

Edwards[1] gives the results of interesting experiments with color in the treatment of mental alienation. He says that "the recent experiments of Doctors Bond and Monette, under the oversight of Dr. E. C. Dent, the Superintendent of the Woman's Hospital on Ward's Island, seem to show the value of the color treatment for the insane, the fundamental principle of vibrational influence being the same with that ruling in musical therapeutics. Patients are placed in rooms painted in one or another of the primary colors, according to the type and stage of their malady, and they generally manifest the favorable

[1] *Op. cit.*, p. 175.

effect of the color environment. The black room is used for cases of acute mania. The patient placed in it, and thus removed from all aural and visual disturbance, usually soon becomes quieter. Red, with its high vibration frequency, is employed for subjects of melancholia. From the red room they are removed to one in deep pink, then to one of a flesh color, and, finally, to a white room."

The first consideration in schoolroom decoration.

Let us glance now at the practical application of the principles we have been considering to the decoration of the schoolroom. The purpose in such decoration must be, of course, to present most effectively those colors and forms, and that arrangement of furnishings and appointments, and those pictorial representations that will afford pupils the greatest pleasure. In schoolroom decoration attention should be given first to the coloring of the walls and furnishings, and the æsthetic characteristics of all schoolroom appointments, and materials used by pupils. Pictures are of service, but they are not of primary service. A room in which half the wall space is covered with blackboard, while the rest is toned with dust and smoke and mortar, — such a schoolroom can never be decorated effectively. Again, a room filled with ungraceful furniture, with desks marred, and bearing the inscriptions of generations of school children, with irregular windows and other spacings, can never be made a really attractive place. But a room full of warm

and cheering, or, if the conditions demand it, cool and soothing, color, and if there be added furnishings of simple, but graceful and æsthetic, construction, such a room is already well decorated. After all, the things that make the deepest impression upon us are those which we use in the attainment of the serious ends for which we are striving in daily life. If these be æsthetic they exert healthful and buoyant influences upon one every moment; if they be ugly they are just as potent for harm.

Great as may be the influence of a fine picture upon the wall, then, it cannot equal that of the thing with which the individual is in vital contact incessantly, and which he employs as means to the accomplishment of his purposes. Some day we shall give more attention than we now do to the æsthetic character of text-books, and tables, and illustrative materials, and all other apparatus of the school. A child who uses a reading book of artistic make-up in all particulars derives more æsthetic value therefrom than he would from the greatest masterpiece of art hung on the walls. And in this connection it may be said that an æsthetic teacher, — æsthetic in features, in figure, in dress, in movement, — is far more potent for æsthetic good in any schoolroom than a hundred pictures. The pupil's relation to the living teacher is so vital that it transcends in importance everything else environing him, especially all that exists for an æsthetic end merely. I would not minimize the importance of pictures, but I

would emphasize the momentous character of these other things that enter into the real, concrete life of the pupil.

TOPICS FOR INVESTIGATION AND DISCUSSION

1. Is the old saying true, that you can tell a pedagogue as far as you can see him? if so, by what tokens does he reveal himself?

2. Can you tell a person who worries? How is worriment revealed outwardly?

3. Discuss the psychology of anxiety, and show why it has such a disastrous effect upon the organism.

4. Do we regard any book as great that tends to increase man's anxieties? Take your favorite book, and speak of it from this standpoint.

5. What musical selections are most quieting in their influence upon you? What ones tend to arouse you most vigorously?

6. What musical instruments are most soothing to you? What ones stimulate you? Do any of them irritate you? Why?

7. What kinds or qualities or characteristics of music please children of different ages most? What airs quiet them when they are excited? What ones excite them? Study this matter on the street, in the schoolroom, and in the home, to see if you can find answers to these questions.

8. Do children enjoy solo singing? Are they affected more by the masculine or by the feminine voice? Do they enjoy chorus singing? Are they quieted or stimulated by it?

9. Have you ever observed how your "nerves" are affected when you are in a house filled with bric-a-brac? Are you affected differently when you are in a house more simply but

artistically furnished? What application of the principle involved may be made to the furnishing of the schoolroom?

10. Public school art associations all over our country are becoming very active in placing in the schools reproductions of great works of art. Suppose they cover the walls of schoolrooms with the finest pictures, but stop at this; will they have served pupils in the most effective way? If you think not, say what it would have been better for them to have done.

CHAPTER XVI

SOME COMMON WASTEFUL PRACTICES

Waste from excessively fine work.

The squandering of one's forces may be due to factors other than a mind ill at ease with the world. The implements children employ in their school tasks are often responsible for considerable needless drain upon the nervous system,—such apparently insignificant things as writing pens, pencils, and the like. To appreciate the principle here involved one needs to remember that the highest brain centers exercise a general control over more fundamental ones, and are charged with the management of peripheral activities, such as those involved in writing, speech, etc. Now, it seems to be the case that peripheral coördinations fatigue children, and it may be adults also, more readily than coarser, less intricate activities. Thus, fine needle-work is, hour for hour, more fatiguing to most women than washing dishes; and "getting pigs out of clover" is a greater strain on most men than playing golf or croquet; though habit and taste are, of course, important factors in these matters. It seems to be a rational inference from the known methods of cerebral action that in the majority of individuals, particularly during the developmental period, activity

of the highest level areas results in the liberation of a larger amount of energy than is actually required to perform the work in hand. Peripheral activities, especially in the early years, are not in any thoroughgoing way differentiated from the more general or central activities; they have been developed relatively late in the race, and the nerve centers controlling them are not yet, seemingly, for most people, quite independent in the individual. It is conceivable that some, perhaps most, of the paths for the discharge of nerve force required for the execution of complicated peripheral actions have not yet become well established, so that in highly coördinated work much energy is apt to overflow into by-paths, so to speak. On the other hand, the fundamental motor coördinations have become so habitual that they can apparently be performed without waste. When a boy is washing off his slate one will notice fewer wasteful tensions and actions than when he is trying to write in a finely coördinated way; and the principle seems to have universal application.

The position here taken is by no means fully warranted by experimental evidence; and there are those who maintain that through habit the individual may get to be as economical in the use of peripheral as of fundamental muscles. My observations, however, lead me to a different view. Adult students tell me that very fine microscopical work with exact representation in drawing

always fatigues them more readily than coarse activities of any sort. Professors who write much have told me that a very fine-pointed pen on highly glazed paper, or paper that is readily punctured either, is exceedingly "trying to the nerves." I was able recently to gain an item relating to this point from the experience of a distinguished physician in Buffalo, a specialist in diseases of the nose and throat. Some of his work involved very delicate operations requiring accurate coördinations of the fingers. He says he never undertakes such cases except in the morning hours, when he is at his best; and after a relatively short period he generally is fatigued, so that he feels it necessary to secure rest before continuing with his duties. On the other hand, a half day's work in his general practice, which does not involve such exact coördinations, will not overtax him. For myself, writing with a fine pen or hard pencil relatively soon exhausts my store of energy and of patience; and I found recently, while experimenting with writing pens, that other teachers had experiences like my own. Even if these considerations were immaterial as they applied to adults, still they would be of immense importance in their application to children.

Waste in unhygienic writing.

Put a child of seven or eight to writing with a fine-pointed pen, and in a short time you will observe tensions in various parts of the body not employed in the writing. Often the tongue will be extended, the hand

not engaged will become clenched, the head will begin to keep time with the arm; the whole showing plainly, it seems, that the coördinations demanded in the writing have liberated energy which escapes into channels which should be kept closed up. On the other hand, if you put this pupil to writing with chalk at the blackboard he will be able to continue for a much longer period without apparent overstrain. One will be impressed with the wastefulness of delicately coördinated activities undertaken too early, if he will observe the effect of requiring young children to do fine sewing or weaving, or any work of this sort, whether in the home or in the school. In some nurseries the young are provided with small toys and fragile objects that have to be handled with care, and so far as I have observed such children are never either vigorous or happy. There is usually a good deal of petulance and irritability in these nurseries, for the reason, doubtless, that the children are in a more or less nervous, uncontrolled condition because there

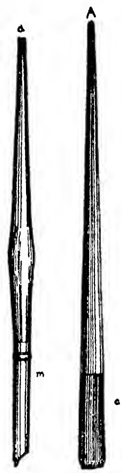

FIG. 20. — Illustrating different styles of penholders.

In *a* the part *m* is metal, usually tin, and is of small diameter.

In *A* the part *c* is cork and is of a considerably larger diameter than *m*.

A answers the purpose of economy much better than *a*.

have been demanded of them activities for which they are not prepared. It is recognized, of course, that with the development of the nervous system greater delicacy and complexity of coördinations become possible with less waste; but yet it is probable that the average individual never reaches a point where he can economically undertake intricate coördinations where coarser ones would answer just as well.

Concerning writing pens. This leads to a few practical suggestions respecting some of the implements which are used extensively in the schoolroom. And first the writing pen. Pupils write on the average from one to two and one-half hours daily, and it is a matter of prime importance for them to do this work with the least possible waste. The less energy that is spent in manipulating the pen the more that will be left for the elaboration of ideas to be expressed by its aid. The mechanical factor must be reduced to the minimum. Now fine-pointed pens are, at least for young children, an abomination. So are hard lead pencils, especially when used on glazed paper. Perhaps the most wasteful implement of all is the common penholder, *a* in the illustration. The fingers grip the small metal part *m*, perspiration readily accumulates, and the pen tends to roll in the fingers. To overcome this the holder is gripped more tightly, with serious results in the squandering of energy. In *A*, the part *c* is of cork, and is relatively much larger than *m*. It absorbs the moisture from the

fingers, and so is managed without so great tension. I have tried many pupils with both these holders, and they have always told me they liked *A* much better than the other because it is "so easy." The same principle applies to lead pencils. A highly glazed surface involves waste because it cannot be managed without excessive tension of the peripheral muscles. Slates are probably the most wasteful of all the appliances of the school.

"Scratchy" pens cannot be too severely condemned. Aside from their irritating influence upon the nervous system, they require such careful handling that waste of energy cannot be obviated. I have never known a person to write long with such an implement without manifesting fatigue in body and mind. Pupils who employ such articles to save time or money in getting something better belong to the penny-wise and pound-foolish fraternity. Gold pens are generally much better than steel, for they can be handled in a rougher way without abrasion of the paper; and steel pens corrode easily, the points thus becoming rough, which prevents easy manipulation.

Needless muscular tensions wherever they occur must be regarded as squandering vital force.[1] Thievery of

[1] A Berlin nerve specialist has advanced the theory that no child should be allowed to learn to play upon the piano before the age of sixteen. He had his attention drawn to the chronic nervousness of many pianists, and so studied the piano from a pathological standpoint.

Out of one thousand young girls whom he examined, each of whom

Postures that lead to waste of energy.

the most serious kind is likely to be taking place constantly. Now the body in either a standing or sitting position is, of course, acted upon by gravity, and if it be out of plumb it tends to fall. This catastrophe can be averted only by the action of muscles which pull against gravity, and so serve to keep the body in equilibrium. Imagine then a person standing for some time in such a position that gravity has a leverage on him, and his muscles are at work striving to keep him from falling; it is easy to see what this means in loss of nerve force. Pupils, or adults either for that matter, who do not habitually stand or sit so that the body is well poised, and there is no undue tension, will certainly suffer for their error in lessened efficiency in both physical and mental work.[1]

had begun to study the piano under the age of fourteen, no less than six hundred had some nervous malady; while out of one thousand who had never studied that instrument, only one hundred were afflicted.

[1] Meyer (summarized by Burnham, *op. cit.*, p. 40), discussing the mechanics of sitting says: "The two seat-bones are curved like a bow; a line joining the lowest points of these two bones is called the seat-bone line; the center of gravity of the body is in front of the ninth or tenth chest vertebra, and a straight line from this point to the ground is the line of gravity. Upright sitting is possible only when this line passes through the seat-bone line. This line determines the surface of support for the body. But the least movement that displaces the center of gravity makes upright sitting impossible without great muscular effort."

Recent investigation has established certain principles of hygienic seating, which have been presented by Lincoln, Barnard, Marble, Meyer, and especially by Shaw, in our own country, and by many hygienists

This subject is of consequence not simply from the point of view of conserving energy, but it concerns as well the generating of force. A pupil leaning over his desk, with his lungs constricted, is in a good condition to encourage day-dreaming and napping. Under such

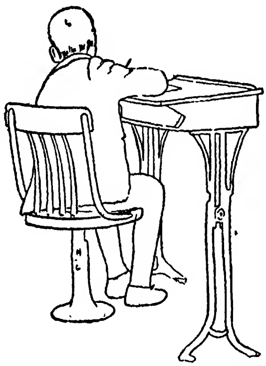

FIG. 21. — Illustrating a desk too high for the child, causing elevation of the right shoulder in writing and a corresponding curve in the spinal column. — BARRY, *The Hygiene of the School Room.*

circumstances the organism becomes clogged, since it does not receive its due of oxygen, as a result of which the brain must inevitably slow down in its action. Who has not seen a room full of seekers after knowledge, lying down on their desks, with all vital processes impeded,

abroad. All agree upon the fundamentals of seating, and any reader who is interested is referred to Professor Shaw's full discussion of the whole matter in his "School Hygiene."

NOTE. — Figures 21, 22, 23, 24, and 25 are from Barry's "Hygiene of the School Room." Copyright, 1904, by Silver, Burdett & Company.

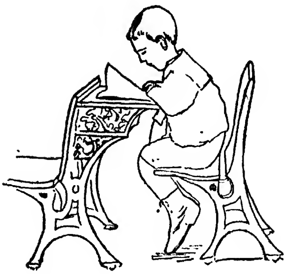

FIG. 22.

FIG. 23.

FIG. 22. — Illustrating a very common fault in school furniture, a too high seat. The child is unable to rest the limbs on the floor and leans over on the desk for support. — BARRY.

FIG. 23. — Illustrating a too small distance between the seat and desk, causing pressure on chest and stomach. — BARRY.

FIG. 24.

FIG. 25.

FIG. 24. — Illustrating too great a space between the seat and desk, causing pupil to stoop too much, inducing round shoulders. — BARRY.

FIG. 25. — Illustrating a desk and chair too small for pupil's size, causing cramping of the lower limbs. — BARRY.

and their minds in a kind of stupor? People sometimes put themselves to sleep by deliberately getting into the attitudes which school seats often enforce upon pupils.

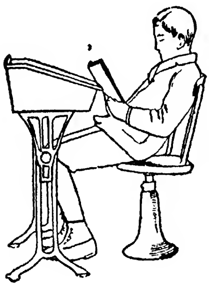

FIG. 26.

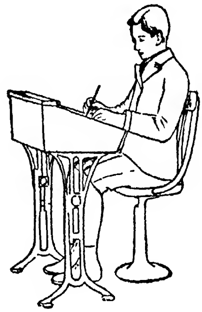

FIG. 27.

FIG. 26. — Illustrating an evil posture very common in schools where the seating is imperfect. — SHAW, "School Hygiene."
FIG. 27. — Chair and desk illustrating proper seating of pupil. — SHAW.

Common errors in seating are shown in Figs. 21–26, while the correct form is shown in Fig. 27.

Danger of overstimulation.

Before concluding this chapter one further method of squandering the energies of children may be mentioned — overstimulation. In many homes and schools, especially in our cities,[1] they are, from the cradle up, sub-

[1] "The American child is the most nervous child in the world. It has more automatisms than any other child, according to the child studies that have been made. It is more easily upset; its mind is quick and alert; it matures younger than with most children. The American child is

jected to continual excitement, which is as inimical to the right development and hygiene of the nervous system in childhood as the whirl of society or the crush of business in maturity. According to the fashion in many households, infants of a few months as well as children of maturer years are permitted to be in the presence of the older members of the family much of the time. Guests always expect to see the baby, to hold it, and to stimulate it in all sorts of ways to see how prettily and intelligently it reacts. This practice would not be so objectionable if it were not that when the average adult has a little child in his arms he is usually intense and restless in voice and actions. Few people seem to appreciate how much such treatment taxes the nervous strength of an infant. But let an older person imagine what a strain it would be to have excited people about him constantly, tossing and patting him, and making all manner of facial and vocal demonstrations for his entertainment. How much more it must wear upon a child to whom these things are new and strange, all arousing the strongest emotions of fear, curiosity, or excitement, and thus draining the plastic, immature brain of its vitalities!

The teased child.

It is not alone the trials of meeting strangers that are extremely fatiguing to young children, but the experiences

liable to get overnervous; to have that dreadful twilight fever when the candles are first lighted; to be unable to stop play, unable to go to sleep readily; to have jumps and twitches when it does go to sleep."—HALL, *Primary Education*, May, 1903, Vol. XI, p. 216.

with parents and other members of the family are often as exhausting. The young child, with its fresh, innocent ways, is not infrequently regarded as a plaything for the entertainment of its elders, and so is teased and tormented in one way or another, because its responses are so novel and interesting. Of course, parents would not call such treatment teasing, but it is precisely what it amounts to from the child's standpoint.[1]

The writer recently had opportunity to study with some care the effect which a woman with a high-pitched, exciting voice and intense nervous face and manner, but otherwise of most estimable characteristics, had upon a little child, H. Whenever she was near H. she

[1] Here is a scene which is typical of much that may be observed in one's environment if he has occasion to look for it. A child disliked greatly to have anything touch its nose, and would make the liveliest efforts to dispel whatever came in contact therewith. The sweet baby movements were naturally amusing to an adult, who did not see anything in them but fun for himself. Frequently some mature person, who knew the child's characteristic in this regard, would place a finger or other object near the delicate member, to see the little one strive with arms, head, and body to drive it off. On one occasion a woman, whose years should have taught her better, was seen to tantalize the child for some time, until finally it became fatigued. When it grew restless and began crying, it was grabbed up, tossed and thrown about, and talked to in a loud voice. This violent stimulation overcame for the moment the child's impulse to cry, but had the effect to further fatigue it, which was shown later in continual crying until it fell asleep. If one will think of such things going on day after day throughout the early life of the child, the irritable, unbalanced, disagreeable children of one's acquaintance may be accounted for at least in part.

insisted upon taking her, and she thought the proper mode of entertainment was to shake and toss and pat her, and make a great amount of noise and ado over her. As a consequence a half hour of such treatment was enough to fatigue H. for a whole day, and her disposition at such times would be quite changed from a happy, good-natured child to one easily irritated and satisfied with none of her ordinary pleasures. A nervous, irritable parent will breed these qualities in his children, because his personal contact will overstimulate them, and they will be in a state of chronic fatigue. Such a parent will be apt to nag his children, to be constantly forbidding or commanding, and this arouses emotions which draw off the energies from the brain very rapidly Antagonism is a breeder of nerve fatigue, and some children seem hardly ever to be free from it during waking hours. The principle applies to the schoolroom as fully as to the home.

Again, in many homes older children make the life of the younger ones wretched much of the time. The writer knows a family where there are three children, the youngest about two years of age. The older ones seem to find no greater pleasure than to tease the babe on every opportunity, for she occasions them much merriment by her violent vocal and bodily expressions whenever she is tormented beyond endurance. One does not need to remain about this home long before seeing plainly

that this child is being worried into an ugly disposition. Even at two years she has reached the point where she is intolerable much of the time, showing her unbalanced condition by flying into a passion over every little thing that occasions her displeasure. The attitude of the older children serves to keep her in a more or less constant state of fatigue, and the actions performed in this condition are rapidly forming habits, thus determining her character.

The effect of noise.

Finally, noise seems to have an exciting effect upon an individual at all times, even when he is asleep. It appears that there is in the soul a sort of memory of earlier racial experiences where noise was a most significant affair. An animal that could not awaken instantly upon sounds of howling or crackling or crunching or breathing in his vicinity would have little chance of escaping from enemies lurking everywhere. And now, although man is quite safe in an environment of any amount of noise, yet he has not fully outgrown this old racial tendency to awareness when he hears noises. The effect of noise upon a sleeping subject has been studied by Lombard and others, and the results seem conclusive in showing that even a slight disturbance causes a decrease in peripheral blood supply, as shown in Figs. 28 and 29, indicating that the blood is flowing in increasing quantities toward the brain, which tends to return to the waking state. In the first hours of life an infant will jump with fright if

you speak in a loud voice near him, or if a door slams, or if any other loud noise plays on him. So when older children hear noises on the street they are excited, and are impelled to action of some sort. How a drum will

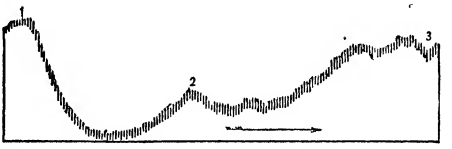

FIG. 28. — Plethysmographic record from the arm of a person sleeping in the laboratory. A fall in the curve indicates a decrease in the volume of the arm. The curve is to be read in the direction of the arrow. 1, the night watchman entering the laboratory; 2, the watchman spoke; 3, watchman went out. These changes occurred without waking the subject. — DONALDSON, *op. cit.*, p. 289.

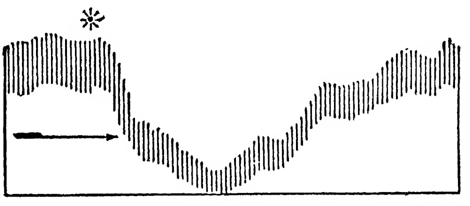

FIG. 29. — Record similar to that above. Change in the volume of the arm of sleeping subject, caused by the sound of a music box which was started at *. — DONALDSON, *loc. cit.*

stimulate a child! And this leads to a practical point. A drum may be a cause of overstimulation if used too continuously, and the same is true of all noise-making toys. A barking dog in a house with children will be likely to excite them too greatly. I have observed the

effect upon several children of three loud-barking dogs gathering about them whenever they go out to play. They are continually excited and show that the experience is fatiguing. An adult will find that he can with difficulty endure this peculiar form of stimulation for a long period.

TOPICS FOR INVESTIGATION AND DISCUSSION

1. Try this experiment upon yourself: do all your writing for a given period with a pen having a metal holder of the smallest diameter you can find. Then for another period of equal length do your writing with a pen having a cork holder from two fifths to one half an inch in diameter. Compare your experiences, and make applications to the work of teaching.

2. If you write much with a fountain pen, try the plan of using a close-fitting rubber tube drawn over the part grasped by the fingers when you are writing, making it about one half an inch in diameter. Note whether you can write with greater ease with the device.

3. How long at a stretch can children of six years write with medium-pointed pens without overstrain? Can they write for a longer period at seven years? at eight? Make observations upon the pupils through the grades. How can you tell when they are becoming fatigued?

4. From the standpoint of economizing nervous energy, describe the materials pupils should use, speaking of pens, pencils, paper, sewing utensils, etc.

5. Is there danger in insisting upon too precise articulation with young pupils? Should physical exercises in the lower grades be of the fundamental or the accessory type?

6. What is the objection to small print in children's books? (See the following chap.) Have you observed that books now coming from the press are printed in larger type than formerly? What about the use of the ordinary school dictionary regarded from this standpoint?

7. Should high school students be required to do much precise work with the microscope? Should they be held for precise work in draughting?

8. Are "fancy work," knitting, sewing, and the like to be recommended as recreation for girls who are in school five hours a day? Mention beneficial exercises for such girls, with reasons.

9. In the spirit of our present discussion, what forms of recreation would you recommend for school boys of different ages? Mention some common occupations or amusements that should be avoided by such boys.

10. Speak in detail of the methods you would adopt in preventing wasteful postures of pupils in the schoolroom.

CHAPTER XVII

THE EYE IN RELATION TO NERVOUS WASTE

WHEN one reflects upon the matter he can hardly fail of being impressed with the remarkable intricacy of the motor coördinations required in the proper control of the eyes. During waking life they are well-nigh incessantly changing their focus, for one thing, so as to bring within

Work of ocular muscles.

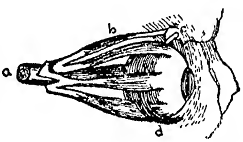

FIG. 30. — Muscles of the eyeball. — *a*, optic nerve; *b*, superior oblique muscle; *c*, pulley; *d*, inferior oblique.
The other four are the recti. — LE CONTE.

range of vision objects located in different parts of the visual field. In order to accomplish this they are equipped with ocular muscles (Fig. 30) so adjusted as to secure movements in all directions within a given orbit. In the perfect eye these muscles are exactly balanced in their pulling capacities, and remain at rest except when the interests of vision require action.

But it happens often that one of the ocular muscles

Maladjustment of ocular muscles.

may be more energetic than its fellows; or through some error in the functioning of the reflex nervous mechanism it may be active when it ought to be quiescent. It tends then to pull the eye out of focus, which would make one see double if it had its way; but the nervous system seeks reflexly to avert this calamity by stimulating a muscle opposed to the overacting one so as to counterbalance its efforts. Nature strenuously endeavors to correct all defects of this character. "When necessary, the nerve centers enervate to their utmost power the various eye muscles, causing a change in the crystalline lens, stretching muscles which were too short to enable the eyes to look in the same direction."[1] This results then in incessant muscular strain which is a constant source of waste. Gould,[2] the distinguished oculist, says that "The tremendous influence of eye strain upon disposition, character, and vocation was borne in upon me the first year I was in practice. Almost every day since then the truth has become more striking and evident. Children's lives and minds are unconsciously and constantly modified, always unnaturally and morbidly, because of the fact, unconscious to them, that reading and study and writing irritates and disorders the central nervous system, the digestional organs, etc."

Again, in the normal eye the lens and eyeball are so

[1] Prentice, "The Eye in Relation to Health," p. 10.
[2] In his "Biographic Clinics," Vol. I, p. 28.

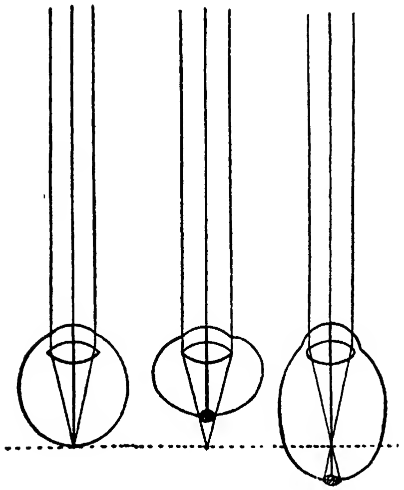

FIG. 31. FIG. 32. FIG. 33.

The term "refraction of the eye" is used for the refracting power of the eye in repose, without any exertion of the accommodation muscle. Refraction is normal, that is, the axis of the eye is of normal length, when rays of light which come from infinite distance are focused exactly upon the retina itself. In such a case we say that the refraction of the eye is emmetropic (from *emmetros*, "of the right measure," and *ops*, "the eye"). (Fig. 31.)

Again, the axis of the eye may be too short, so that rays coming from infinite distance are focused at a point behind the retina; this refraction is termed hypermetropic ("going beyond the measure") or hyperopic (Fig. 32). This hyperopia must in no way be confounded with that long sight often noticed in old age, when the patient sees clearly only things at a distance, a defect caused by weakness of accommodation.

Lastly, the axis of the eye may be too long, so that rays from infinite distance are focused in front of the retina (Fig. 33). This kind of refraction is called short-sighted or myopic (from *muein*, "to blink," and *ops*, "the eye") because most short-sighted people nearly close their eyelids when they try to look at any distant object. (Cohn.)

Maladjustment of the lens.

constructed that objects are with ease focused exactly upon the retina. But it happens more frequently than not, it seems, that this fine adjustment is not secured. The lens has not the right degree of curvature, as a whole, or in a certain angle, or the eyeball is either too short or too long, when the focus falls in front of or behind the retina, or is not the same in every angle (Figs. 31, 32, 33).

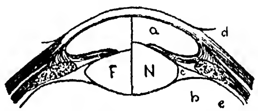

FIG. 34.—*F*, lens adjusted to distant objects; *N*, to near objects; *a*, aqueous humor; *d*, ciliary muscle; *e*, ciliary process. (Le Conte.)

In a more or less reflex way the individual tries to remedy any error of this sort by modifying the curvature of the lens through the delicate ciliary muscles (Fig. 34). In a defective eye this strain must go on incessantly, and one can easily imagine the effects in draining the organism of nerve force. We are hearing these late years that the eye is the source of a large number of diseases; and even if its importance in pathology has been somewhat exaggerated it is, nevertheless, universally conceded that defective vision entails most serious consequences, alike in blocking one important approach to the mind and in robbing the system of its energy.[1] In the defective eye

[1] Swift, in the *American Physical Education Review*, 1899, gives a number of examples of disturbances in various parts of the body, due directly to eye strain. Here is an instance: "About nine years ago a

these muscular tensions go on hour after hour, and only the most hardy constitution can endure the strain, as Ranney,[1] Prentice,[2] Cohn,[3] James,[4] and many others have repeatedly pointed out.

Dr. Gould on the effect of eye strain

Gould,[5] in his interesting study of the causes of the ill-health of some of the great men and women of history, — Darwin, Huxley, the two Carlyles, Spencer, Wagner, and many others, — maintains that eye strain was responsible for most of their maladies. In discussing De Quincey's ill health, he makes a statement which will be in

man came to Dr. Alcorn for examination. In the course of the inquiry the following facts were learned: During the three preceding years the patient had suffered from three attacks of what his physicians diagnosed as paralysis. For about three months after each attack the man was afflicted with sensory aphasia. He was unable to interpret written or spoken words. He could pronounce words, but they had lost their meaning for him. During the entire three years he had been unable to attend to any business. The visual acuity of his left eye was twenty twentieths, and of the right eye about six two-hundredths. Under a mydriatic the left eye manifested a slight degree of hyperastigmatism. The patient returned in three months and said that he 'had entirely recovered and was attending to his business regularly.' About one week since he was again seen and reported that he had never felt any symptoms of a relapse since he began wearing the glasses nearly nine years ago, except on one or two occasions, when his glasses had become twisted, or when he had laid them aside for some reason."

1 "Eye Strain in Health and Disease."

2 *Op. cit.*

3 "Hygiene of the Eye."

4 "Suggestions to Teachers Regarding the Visual Defects of School Children."

5 "Biographic Clinics," two volumes and several pamphlets.

place here. "It is one of the greatest of unutilized truths," he says, "long known, strangely ignored, that in the vast majority of cases of eye strain the morbid results of the astigmatism, etc., are not felt in the eyes. It is perfectly explainable why this is so. The value of the eye so overtops that of almost any other organ that the reflex results of its unphysiologic function must be shunted anywhere except back to the eye itself. In women it goes to the head; the world is full of those tortured nearly every day of their lives with headache ('bilious' or 'nervous' headaches). In many, and especially with men working much with the eyes, the reflex is to the digestional organs, with 'indigestion' and 'liver derangements,' 'anorexia,' etc. The truth that eye strain induces these functional gastric, intestinal, and biliary disorders cannot much longer be ignored." [1]

Eye defects seem to manifest themselves especially during adolescence. A great many boys and girls realize now for the first time that they have eyes. The explanation doubtless is that the organism is now devoting its strength mainly to the building of heart, and lungs, and bones, and there is not much left to expend in disciplining refractory eyes. In sickness people become conscious of eye strain that they have not noticed before, and of which they are never really aware except when the energies of the organism are at a low ebb. Swift observed this phe-

[1] See his "Biographic Clinics," Vol. I, pp. 34-35.

nomenon frequently in his study of vision in the pupils of the normal school at Stevens Point, Wisconsin. "An interesting fact," he says, "though by no means a new one, was repeatedly observed. Young boys and girls, with more defect than some older ones, had never experienced any trouble with their eyes, while the older ones, with much less defect, were constantly annoyed with eye ache, or the blurring of the letters. The difference was that the vigorous nervous system of the young boys and girls was able to sustain the irritation of the poorly constructed eye, and by an oversupply of nerve force, could compel the eye to do its work without apparent injury, while the more exhausted nerve centers of the young men and women could not stand the constant call for more energy."

The prevalence of eye defects

One observing people on the streets of our American cities must be impressed with the relatively small number who are spectacled. Whatever opinion he may hold regarding the relation of spectacles to mental attainment, he must at least conclude that many are wasting energy in combating visual defects that ought to be remedied by glasses. Investigations made within the last decade in various parts of our own country and Europe show that on the average 30 per cent of individuals have defects of vision which require correction by lenses.[1] And the de-

[1] See O'Shea, "The Right Physical Start in Education," in the *World's Work*, August, 1903. In this article I give the results of an extensive ex-

fects increase with age; as high as 40 or 50 per cent of the children in the upper grades in some places have defective sight. According to Cohn myopia increases rapidly with age in the German schools; "in the real-schulen the myopia percentage from the sexta to the prima were 9, 41, 16.7, 19.2, 25.1, 26.4, 44; in the gymnasia 12.5, 18.2, 23.7, 31, 41.3, 55.8." Professor Swift's researches indicate that at least three fourths of the students in his normal school had some visual defect. In Rochester, New York, 31 per cent of the children in the high school, according to the principal, have defects of vision which can be detected without any expert examination. And so it goes. Prentice, Cohn, and others have recently argued that no individual can afford to go through life without ascertaining the true condition of his eyes; and Ingalls says it is useless to put a child at study when he is afflicted with some eye trouble, either of refraction or of muscular action. Because one is not conscious of a defect is not conclusive evidence that he does not possess it. I take my vision to be the standard, the normal, unless some one or some event teaches me better. The only safe course is to have my vision measured up to a norm or standard; and if it does not fulfill requirements to call the oculist and the optician to my aid.

For the most part the eye has been used throughout

amination of the sense defects of the school children of Madison, Wisconsin, and I also summarize the results of examinations made elsewhere.

The wastefulness of reading excessively fine print.

racial history in discerning relatively large objects and those at a considerable distance. It has been only within the most recent period that such visual coördinations have been required as are necessitated in the reading of print. Authorities agree that a child of five or six, for instance, has not developed the visual ability to read fine print with safety. When a child of this age is set to studying a primer printed in small type, he is likely not only to suffer great strain, but injury is apt to result to the visual organ. It is probable, too, that even in adult life the reading of very fine print requires coördinations of ocular muscles which result in waste of nervous force. Cohn, Sanford, Weber, Cattell, Javal, and others have calculated the size and shape of letters and the characteristics of print which can be read with greatest ease, and every teacher should become familiar with the results of their studies.[1] Dr. Cohn summarizes his views as follows: "In the future I would have all school authorities, with measuring rule in hand, place upon the *Index librorum prohibitorum* all school books which do not conform to the following measurements: The height of the smallest 'n' must be at least 1.5 mm. (.06 inches), the width between the lines must be 2.5 mm. (.1 inches). The least thickness of the 'n' must be .25 mm. (.01 inches), the shortest distance between the letters .75 mm. (.03 inches), the greatest length of text line 100 mm.

[1] They are summarized by Burnham in the *Ped. Sem.*, June, 1892.

(4 inches), and the number of letters in a line must not exceed 60."

Defective vision as a cause of dullness and irritability.

In conclusion, I may call the attention of teachers to the necessity of looking to the eyes for an explanation of shortcomings in their pupils. Many writers have in recent times maintained that defective vision is the cause of much dullness and irritability in the schoolroom, and it will not be needful to go into the theory of the matter here. I wish, though, to give the notes made under my direction by Professor Ray[1] upon two pupils who have given their parents and teachers much trouble. These pupils were carefully observed for a considerable period, and their cases are typical of others we have on record.

General Report, Case 2. — A boy who has been observed for a period of three years. At the age of five he was thought to be in good physical condition, but was regarded as an incorrigible lad. He was disobedient in the extreme, seemed to be unhappy and continually interested himself in making others unhappy. He made no progress in kindergarten work. His drawings, so far as they could be said to have shape, were always inverted. An inherited stupidity was all that could account for this condition. "John never will learn anything anyhow, he can't do anything like the other children," was the best that could be said of him. Entering the public school at the age of seven, he manifested the same disposition and the same lack of ability to learn. The boy is now taken care

[1] The results of Professor Ray's studies have been embodied in a Thesis, now in the library of the University of Wisconsin.

of. It was with difficulty that the oculist reached his case, but when it was accomplished he was at once a new boy. Some time elapsed before he had a proper conception of form, but the old habits were gradually overcome, and he became a rapid learner and happy and docile in disposition.

The cause of the irritable and nervous condition of this lad was due to the effect of the disordered eye upon the nervous organism and, perhaps, no less to the fact that he was unable to share in the knowledge which other children were obtaining because of his weakened powers of perception. After his treatment by the oculist, his knowledge of objects was soon observed to be more definite and complete, and afforded him increased interest and pleasure.

General Report, Case 3. — A boy under observation for three years. Because of myopia and astigmatism, he was evidently unable to see well enough to understand with other children, and acquired a habit of dependence and indifference. Pain from the use of the eyes gave discomfort and dislike for school. At the age of seventeen he is greatly aided by the use of glasses in gaining knowledge from books and takes much more interest in study, but the habits acquired in the earlier years cling to him. He is slow in speech, but likes to think and learn best from listening to others, and is much interested in matters for debate. With improvement in his ability to see has come also improvement in moral principle and consideration for others. Without question, if his eyes had been attended to at the proper time, he would be much more rapid in movement and speech, and have no serious defect in his mental grasp. I have found in every case of eye defect which has had some continuance, and was of such a nature as to interfere with clear vision, that there was defect in motor development.

TOPICS FOR INVESTIGATION AND DISCUSSION

1. Try this experiment: find among your companions one who wears quite "strong" glasses to correct a different defect from your own, if you have one. Put on these glasses for a little time and note results. What is the relation between eye strain thus artificially produced and that resulting naturally from defective vision?

2. If you can do so, get from all your associates who wear glasses a statement of their experience with defective vision. What difficulties has the wearing of glasses corrected? What influence have glasses had on their emotional life?

3. What would you do with a pupil who habitually complained of his eyes "smarting" or "hurting" in the schoolroom?

4. What would you do with a pupil who said he could not read without suffering pain in the top and back of his head?

5. What would you say to parents who object to having their children, who have defective vision, wear glasses, maintaining that they will outgrow their trouble as they get older?

6. Describe practical methods of detecting visual defects in school children. Would it be a satisfactory way to ask pupils if they had "good eyes"?

7. Pay a visit to the nearest elementary and high school, and find out precisely what proportion of the children wear glasses. What is suggested to you as a result of your inquiry?

8. Suppose you have in your schoolroom children whom you know have defective vision, but who for some reason do not wear glasses. Would you treat them differently from other pupils? Do the teachers you know give special attention to visual defects? Did they do so when you were in school?

9. In what ways would you expect a pupil suffering from a marked case of myopia, hypermetropia, or astigmatism to manifest his defect in the work of the school?

10. Does the lighting of a schoolroom have any bearing on the problem of conserving nervous energy? Show how. Comment on a situation where one half of the pupils in a room are far removed from the windows, which are situated on only one side, and that on the north side.

CHAPTER XVIII

THE DAILY PROGRAMME IN RELATION TO NERVOUS WASTE

Concerning overpressure in the schools.

DURING the past decade a great deal has been said, alike in the educational and in the secular press, regarding overpressure in education. Physicians and educators have noted with great apprehension the apparently increasing number of pupils in the higher schools who are deficient in that vigor and robustness of body and mind which are essential for success in the battle of life. We are told that nervous diseases are much more frequent in youth to-day than they were a generation ago, and the fault must lie with the schools, for they pass the safety line in the demands they make upon their pupils. This feeling has been so marked and widespread that many investigations have been prosecuted in Europe, and to some extent in our own country, for the purpose of ascertaining the true condition of affairs respecting the amount of work required of students, and the effects thereof. Thus far little of final value has been attained; but yet the conviction is deepening in the public mind that education is too much of a forcing process, which makes demands upon energies that should be saved for the use of vital or-

gans during their growing periods. Physicians have been urgent in their demands that the work of the schools be lightened.[1] Oppenheim[2] is unsparing in his criticism of the present *régime* as it exists in the lower grades. Keating, after long experience with diseases of children, finds[3] that many of them have their origin in excessive strain incident to school work, and he, too, insists upon reform. Some examinations of school children in Germany have shown that frequently they return to their work, day after day, with constantly increasing fatigue; recuperation does not take place fully during periods of release from recitation and study.[4]

An attempt has been made to determine the amount of study which may be safely undertaken by a pupil at different stages in his progress through the schools. It must be apparent, however, that it is impossible to formu-

[1] Key, in his work on "School Hygiene," is very emphatic in his statements that the children of Sweden are seriously overtaxed. Nesteroff makes similar statements with reference to the Russian school children. The Nuremberg Congress of Hygiene has devoted itself particularly to the question of overpressure, and it has declared that the German school system is too severe upon its pupils.

[2] In his "The Development of the Child," Chap. V.

[3] See his "Mother and Child," pp. 180, 219, 220.

[4] See Kraeplin, "A Measure of Mental Capacity," *Pop. Sci. Mo.*, Vol. XLIX, p. 758.

Ballantyne, in England (see the *Lancet* for 1890, Vol. II), declares that the English children are being seriously injured by overpressure in the schools. In this connection one recalls Spencer's indictment of the English schools, made over a quarter of a century ago.

late any general law respecting this matter. Individuals differ so greatly in the amount of energy which may be expended in intellectual and physical activity that no rule could apply to all. Again, the kind of work done and the conditions under which it is prosecuted must exercise an important influence upon the readiness with which energy is expended. It seems, though, to be the view of those most competent to form an opinion, that children in the elementary school should not spend more than three hours a day in mental labor. This period may be gradually lengthened as the pupil develops, until the limit of not more than eight hours a day is reached in the high school or college. It is important to note, however, that during these eight hours the attention is to be concentrated upon mental tasks; mind wandering and reverie are not to be considered as work.

Taking the situation as it is, it seems probable that the injurious effects of study upon the health of pupils, of which we hear so much, is due more largely to the unhygienic conditions under which the work is carried on than to mental application *per se*. It seems to be true that during waking hours the mind must be constantly active in some direction; and if study can be done under proper conditions, it is probable that it will be no more fatiguing than other sorts of mental occupation. It is, after all, perhaps, not so much a question of the amount of study as of the circumstances under which the study is con-

ducted; except, of course, that if a child spends six or eight hours a day in the school he cannot meet the requirements of hygiene in respect of exercise and sleep.[1]

Less time in the schoolroom

Doubtless pupils as a whole spend too much time in the schoolroom, not only wasting energy, but, what is worse, idling away a good many precious moments, and thereby contracting habits which will be of great disadvantage to them in after years. The statement has frequently been made at educational meetings of late, that children ought to do all the work of the school day in a single hour if their attention could be concentrated upon the tasks in hand. While this statement is probably excessive, yet I am thoroughly convinced that fully one half the time of the average child that should be devoted to exercise is wasted sitting in school seats. This it is that weakens the constitution, and makes children unable to resist disease; it is not intellectual activity in itself. Men like Key,[2] Bancroft,[3] and others have continually called attention

[1] Prolonged examination periods work greatest harm in the schools. In the high schools and colleges students often spend over their books as high as sixteen hours a day for two or three weeks at a stretch. The work is done under great tension, too, which makes it especially wasteful. There is crying need of reform in this respect. I have seen cases of breakdown also in the elementary school, due entirely to the strain and worry incident to examinations.

[2] See Mosso, "Fatigue," p. 319.

[3] See the *Phys. Ed. Rev.*, Vol. VII, p. 33. Note this statement: Sitting, and particularly reading and writing, is abnormal, and is conducive to postures that restrict circulation, respiration, and assimilation, the three fundamental biological processes.

to the danger of children sitting too long at a time. An interesting experiment relating to this matter has been in progress for four or five years in Ithaca, New York. The school day for certain children in the primary grades has been shortened by half, and the results indicate that fully as much is accomplished in one hour under the new *régime* as in two or three hours in the old-fashioned way. In a recent report Superintendent Boynton says that a one-hour class was opened two years ago in connection with the training department school. A number of children were entered for this class, and they were kept at their books only forty-five minutes a day at first, but later the time was extended to one hour, and in the spring quarter it was lengthened to one and one half hours. In the middle of that year a second class of about the same size was organized in a similar manner. The children in both classes were regarded as below the age appropriate for undertaking the work of the primary grades; but, and this is very suggestive, the first class did without difficulty the work of the first grade, and the second class made corresponding progress. When the report was made the first class was doing the work of the first half of the third grade, and the second class the work of the first half of the second grade.

Mr. Boynton declares that the children were in no wise exceptional, and in his opinion the pupils in the primary schools of any city "can be divided into small

sections on short time with the same satisfactory results."

In a private letter he writes: —

"During the past year our first primary grade pupils, who entered school in September, 1900, have not been in school to exceed two and a half hours daily. Teachers are very enthusiastic over the change, and the amount of work done exceeds that of any previous year. . . . In two of our primary schools not only is the work of the first year being done, but nearly one half of the second year will be completed by the close of the school year, June 27. No attempt at crowding has been made; simply, children have worked well while they were in school. When their work was over, they have gone into the open air to play, or to go home."[1]

We need further experiments along this line before we can dogmatize on the virtues of short school days; but it is certainly not hazardous to say that if we could reduce our classes in the primary schools to one half the ordinary size, so that a teacher might keep all pupils vigorously at work, and follow carefully each mind under her care, as much could be accomplished in one hour as in four hours under the ordinary plan, and with far better results to the health and habits of the children. As it is, in class rooms where there are fifty or sixty children, half of the time of the teacher is sometimes devoted to nagging

[1] See in this connection an experiment made by Charles Paget in England, and recorded in the *Journ. of Educ.* (English), Oct., 1884.

pupils; and both the pupils and the teacher suffer greatly under such conditions.

Concentration for brief periods the requirement.

Looking at some of the regulations in accordance with which the programme of the school should be arranged so as to make the energies expended by pupils count for the most, it is apparent, for one thing, that attention must be concentrated upon the topics in hand for unbroken periods, differing in length with individuals, with age, and with the nature of the subject attended to. Binet and Henri[1] and others have shown that it takes a little time to warm up to a subject, so that one can do his best in it. If he applies himself only a few moments at a time, he never reaches his maximum of efficiency. Common sense tells us that one may accomplish more with less effort when he holds his mind to a task than when it is constantly wandering into by-paths; and neurology has produced some evidence giving warrant to this view. It has been pointed out that there is what one might call division of labor in the cerebral factory. In one section is carried forward a certain variety of work, in another a different kind; and so each department has its special duties. Now if one be attending to mathematics, for instance, it is probable that a special department of the brain is particularly active. The memories and the associative functions in that region are aroused and energetic. And the longer one holds his attention to his subject, up

[1] See "La Fatigue Intellectuelle," especially pp. 247–250.

to a certain point, the clearer are subtle relations discerned, and the more rapidly does thought proceed. In a neurological sense this means that the inertia of the brain in special areas is overcome, and energy moves along desired lines with less resistance than at the outset. But now let the attention wander unbidden into another field, and it must arouse inactive regions that for the time being ought to remain dormant. This dissipates both time and vital force.

It must be familiar to every one that solving a problem and learning a poem at the same time is bad economy. So, too, it is a wasteful practice to try to master one's psychology or literature or mathematics while listening to the conversation of a roommate, or while one's mind is idly straying off into neighboring regions of either study or anticipated pleasures. The conservation of mental energy requires that a pupil should have certain periods when he is wholly uninterrupted, and can give his attention absolutely to the work in which he is engaged. He should be out of sight and hearing, in thought at any rate, of every stimulus which tends to distract his attention.

Relaxation.

While economy demands uninterrupted periods for study, yet this does not mean that a pupil should apply himself three or four hours without any relaxation. On the contrary, experience, as well as considerable investigation by Bürgerstein and others, seem to show that greater progress is made in the intellectual operations if attention

be not constrained to a given task beyond the point of fatigue,[1] whatever this may be. If at the approach of fatigue the attention be released for a time it will return to work with renewed vigor, and in the long run the pupil will accomplish more than if he had kept straight on when his powers began to decline. Kraeplin, Friedrich, and others have observed that pupils work best when school sessions are interspersed with short periods of rest.

Attempts have been made to ascertain the span during which attention can be profitably held to a subject; but as in the case of the amount of work which can be done, the result must be purely relative; it depends upon the subject and upon the individual. It is the general opinion, though, that periods of strenuous application should not exceed fifteen minutes in the primary grades, and twenty-five minutes in the highest grades. After this stretch a break of five minutes or so spent in moderate physical activities will aid in restoring nervous tone. It is important, though, that the relaxing exercises should not demand just as great concentration of attention as study. The purpose in relaxing, which was argued in the preceding chapter, is to relieve the will, to set it free, when it will return with renewed vigor to mental tasks. It is a mistake to think that gymnastic exercises take the place of free relaxation periods. During the gymnastic drill the pupil must give active attention, and the brain is thus not

[1] Cf. Mosso, *op. cit.*, p. 152.

greatly relieved, a point noted by Mosso,[1] Kraeplin,[2] Kotelmann,[3] Shaw,[4] and others.

Short exposure with strong stimulation

For economy, then, have short periods of close application, followed by rest. As Superintendent Kratz has said,[5] — "In order to attain the highest possible maximum of mental efficiency, with the greatest economy of effort, provide working periods with more frequent rest periods, and thus secure, through this power of the mind to recuperate rapidly, an almost continuous high state of mental vigor. That which has prevented us in the past from injecting more freely these rest periods into the work periods has been the fear that during such interruptions pupils would lose all the advantage gained, but that fear, according to this statement of our friends, the psychologists, is not well founded. The mind, instead of being, as we supposed, like the old-fashioned sensitized plate of the photographer, which required a long exposure, is, after all, more like the highly sensitized plate of the snapshot camera. Not long exposure, but right conditions, such as proper foundations, close attention, profound interest — these determine the vividness of the mental picture, its permanency, and the degree of strength gained. We need, especially in the lower grades, to bring in these more frequent rest or exercise periods, believing

[1] "Fatigue," p. 280.
[2] *Pop. Sci. Mo.*, Vol. XLIX, p. 761.
[3] *Op. cit.*, p. 184.
[4] "School Hygiene," p. 231.
[5] Add. and Proc. N. E. A., 1899, p. 1091.

that the increments of power gained from mental activity will not be dissipated through such slight interruptions, and that efficiency of public school work will be greatly increased as well as relieved of much of its present drudgery."

The sequence of studies. The sequence of studies in the day's work is a matter of some consequence. It has already been said that special regions of the brain have charge of special mental activities. When, then, the mathematical areas, for instance, have been exercised for a reasonable period, economy would suggest that these be relieved while other areas are employed. To follow one mathematical study by another is not the part of wisdom, unless the first has used but a fraction of the available energy. If it were possible, it would be advisable to keep the attention concentrated upon a subject, number or spelling or geography, until the energy which can be utilized in that direction is largely spent; then turn to another study of a different character. This is not so important for the older as for the younger pupil; a senior in the high school should be able to disregard the law of sequence in studies with less evil results than the pupil in the alphabetic class. The senior can draw more largely upon all his resources for special purposes; he can summon a good part of his strength on occasion. But it seems advisable that with all pupils studies involving different mental activities should relieve one another. This is especially important

in relation to the mental and motor branches. If a pupil has to prepare five studies during the day, three of which require much writing and the other two none at all, it would doubtless be best for him to put the non-writing subjects between the others, so that the cerebral motor regions employed in the writing may perform the required tasks without overstrain.

Finally a word may be said respecting the hours of the day which can best be spent in study, and the hours that can best be devoted to particular exercises. Testimonies recently gained from several hundred students in the University of Wisconsin showed that the majority could work most effectively in the forenoon;[1] and this accords with results reached by Barnes in his study of the habits of Cornell students, and also with the testimony of experience and common sense. The best hours range from seven to twelve in the forenoon, while the choicest period of the day is from nine to eleven; and it would seem that the studies demanding the greatest concentration of attention should come at this time.[2] If the available energy is not used in profitable ways it will doubtless be expended in fruitless activities. It would also appear that when children begin their work at nine

[1] Of course there were some "night workers," who were dull during the morning hours. Recent investigation seems to show that there are persons whose energies are at flood tide in the late evening; but in each case this may be the outcome of habit, and not of natural constitution.

[2] Cf. Mosso, *op. cit.*, Chap. XI.

in the morning little can be accomplished by keeping them at their tasks beyond half past eleven at the longest, without a considerable intermission, during which they may take food. To attempt to keep the children together after this hour will be likely to do more harm than good. They are usually restless in mind and body, and are apt to make many errors which require constant correction, and this always involves waste.

This question of errors in school work has been studied by a number of investigators, and most of them have found that the fewest mistakes are made in the first hours of morning and afternoon, and they are most numerous during the last hours. It will be enough, perhaps, to give Friedrich's conclusions here:[1] 1. "The quality of work done by school children decreases with the increase of the school hours. The best work is done at the beginning of the school session and the poorest at its close. 2. If we compare the work of the morning session with that of the afternoon, the quality of the former is in every instance better. Even a three hours' intermission at noon is not sufficient to reinstate the freshness of the morning. At the close of a two hours' session in the afternoon the children are in a worse condition than at the close of a three hours' morning session. 3. The influence of a

[1] Friedrich's method of investigation, together with some of his tables, are summarized by Patrick, "Studies in Psychology," Vol. I, pp. 80–84. See also Binet and Henri, *op. cit.*, pp. 294 ff.

recess is in every instance to increase the quality of the work, and in a three hours' session two recesses increase it more than one. For instance, one recess at ten decreases the errors at eleven from 162 to 152, and two recesses, at ten and nine, decrease them to 96. In addition to these results, the author compared the quality of the work done in the first half of each experiment with that of the second half, with the result that the best work was uniformly done in the former. It will be remembered that the dictation exercises required thirty minutes and the number exercises twenty minutes. Finally, though the author himself does not call especial attention to this fact, it may be seen from Table 1, that the quality of mental work was lowered and not raised by an hour's instruction in gymnastics from two to three P.M. and indeed lowered very remarkably. This appears to have been work for the children and not rest or play.

"The author's practical conclusions are as follows: — School instruction is for the mentally and physically growing child *work*, and consumes his mental energy. If it becomes overwork, it checks his mental and physical development. It is shown by these and other experiments, and insisted on now by many educators, that short intensive study hours are better than long ones. Especially with children in the lower grades, fatigue increases very rapidly with the continuation of instruction. The child should be granted a recess of from eight to

fifteen minutes after every sixty minutes, the time to be spent in attention to bodily needs, to rest, and to the taking of nourishment. The severer studies should find a place in the earlier morning hours. Whether there should be any afternoon session at all is questionable. At any rate, only light exercises, such as penmanship, singing, etc., should be permitted in the afternoon."[1]

The result of studies by Lombard and Smedley.

Lombard has made a study of the rhythm[2] in the energic conditions of one individual throughout a single day, and although disturbing factors, such as the influence of alcohol, tobacco, and food, make his data in a measure unreliable, still his curve (Fig. 35) is at least suggestive when taken in connection with the testimonies referred to above. Investigations made upon school children in Madison, under my direction, show practically the same rhythm; and more careful studies made under the supervision of the Child Study Department of the Chicago Public Schools have yielded results in general accord with those given, as Figs. 36, 37, and 38 show.[3] Fig. 36

[1] Patrick, *loc. cit.*

[2] In this connection, see a very careful and valuable study on "Periodicity and Progressive Change in Continuous Mental Work," by Seashore and Kent, *Psych. Rev.*, March, 1905; and Monograph Supplement, Univ. of Iowa Studies in Psych., No. 4.

[3] As I pointed out in Chapter XII, modern research has led us to place less confidence than we did originally in the results of these studies, as revealing genuine conditions of fatigue; but it cannot be denied that they indicate a certain rhythm, however this has been established, in pupils' activities which, to say the least, is very suggestive to the teacher.

shows the "course of power" for a school day in the case of a single pupil, which was determined by causing her to lift a weight of three kilograms at the hours indicated.

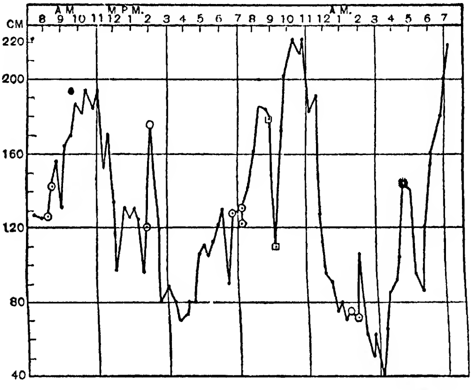

FIG. 35. — Showing at each hour of the day and night how many centimeters a weight of 3000 grams could be raised by repeated voluntary contractions of the forefinger before fatigue set in. The curve is highest at 10 to 11 A. M. and 10 to 11 P. M. Lowest at 3 to 4 P. M. and 3 to 4 A. M. Circle with dot, observation made just after taking food; square with dot, smoking; * work done eight minutes after drinking fifteen cubic centimeters of whisky. — DONALDSON after LOMBARD.

The weight was raised over a pulley by flexion of the middle finger once every two seconds for forty-five times. Fig. 37 shows the course of power for eight pupils tested in the same way at intervals of three quarters of an hour throughout the school day. Fig. 38 shows the results of testing eleven hundred pupils by this method. It can be readily

seen that the flood and ebb periods, at least the large rhythms, are remarkably similar in all cases.

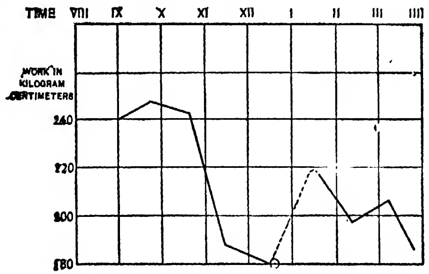

FIG. 36. — Course of power through the school day as determined by the ergographic records made by No. 498.

DATA. — THE WEIGHT, 3 KG., WAS LIFTED ONCE IN TWO SECONDS FOR 90 SECONDS.

Time of Test	9.00	9.47	10.40	11.30	12.18	1.34	2.20	2.13	3.35
Work Done (kg. cm.)	240	249	243	189	180	219	198	207	183

(Report on Child Study Investigation, Chicago Public Schools.)

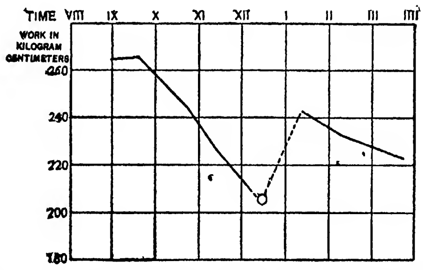

FIG. 37. — Course of power throughout a school day as determined by the average ergographic records of eight pupils of the Alcott School.

DATA. — EIGHT PUPILS (4 BOYS AND 4 GIRLS) WERE EACH TESTED NINE TIMES DURING THE DAY. EACH TEST CONSISTED OF 90 SECONDS' WORK. A WEIGHT OF 3 KG. WAS LIFTED EVERY OTHER SECOND.

Av. Time of Tests	8.51	9.37	10.32	11.20	2.07	1.23	2.08	3.00	34.5
Av. Work Done (kg.cm.)	262	263	249	229	212	243	234	228	224

(Report of Child Study Investigation, Chicago Public Schools.)

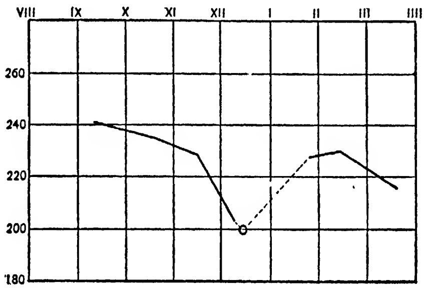

FIG. 38. — Course of power determined from the ergographic records of eleven hundred twenty-seven pupils of the Alcott School.

DATA. — EACH TEST LASTED 90 SECONDS. THE WEIGHT, WHICH WAS SEVEN PER CENT OF THE PUPIL'S WEIGHT, WAS LIFTED ONCE IN TWO SECONDS.

Av. Time of Tests	9.35	10.32	11.28	12.11	1.51	2.31	3.21
Av. Work Done (kg. cm.)	242	237	231	204	227	229	218

(Report on Child Study Investigation, Chicago Public Schools.)

As a last word it may be added that some time ago the *Société d'Hygiène de Genève* formulated rules relating to education to the effect[1] that "the first hours in the morn- **French regulations.**

[1] See Guyau, "Education and Heredity," pp. 139-140.

ing should be devoted to those subjects demanding most intellectual effort. Lessons should be broken off every hour for recreation, allowing each pupil opportunity for bodily exercise." Guyau goes on to say that "the Académie de Médecine appointed a Commission to find a remedy for intellectual overpressure. This Commission drew up a report; the principal items affecting primary education were as follows: 'From three to eight hours per day, according to the child's age, should be the limit of intellectual work. Twenty to thirty minutes should be the outside length of each lesson for children; the syllabus should be reduced in proportion to the length of the lessons and time of preparation; at present the examinations cover far too wide a ground, are too encyclopedic; *partial and frequent* examinations should be substituted for them, limiting the intellectual strain. . . . It is necessary to devote, according to age, from six to ten hours a day to physical exercise (games, walks, drills, etc.).'"

TOPICS FOR INVESTIGATION AND DISCUSSION

1. Give as much attention as you possibly can to the following question: Are children's diseases more common during school sessions than during vacation? If you can do so, investigate this matter in reference to particular cases, and note what troubles, if any, increase when children begin school, and what are probably the causes therefor.

2. Make observations upon the children in your neighborhood in the effort to find out how much time they spend out of doors in play or work when school is in session. Compare this amount with that spent out of doors during vacation. What inferences may be drawn from your observations?

3. Are the school buildings in your neighborhood in the vicinity of playgrounds where the pupils may exercise at recess? If not, how do they secure relaxation during the school day?

4. Comment on the following situation: The school building is located on a busy street, but is surrounded by a strip of green grass. The teachers forbid the pupils stepping on the grass; and they also warn them against being a nuisance on the street. They must keep out of the way of pedestrians and vehicles, and they must not shout or make any noise which will disturb residents or passers-by. Further, the pupils are forbidden under heavy penalties to run or play or shout within the building during intermissions.

5. Comment on the plan of some teachers of keeping pupils in at intermissions and after school at night as a penalty for violation of rules, or as a punishment for failure to "learn their lessons."

6. Should gymnastic exercises be made a substitute for recesses? Why?

7. Make out a typical daily programme showing how a pupil should spend his time in the primary school; in the grammar school; in the high school.

8. Make out a typical daily programme, showing the sequence of studies in the elementary, grammar, and high school, with reasons therefor.

9. Study a school in which pupils are held for long periods, two hours, say, without any recesses. Note whether toward

the close of this period pupils are as attentive to their work and as accurate in it as when they began. Note whether they are more or less restless than at the opening of the period.

10. When bright and dull pupils are taught in the same classes, what methods should be adopted to avoid keeping the bright pupils in their seats while the dull ones are plodding their weary way?

CHAPTER XIX

RÉSUMÉ

THE physical organism, regarded from one standpoint, is a contrivance for generating energy needed for the support of all activity, whether physical or mental. When the stock of available energy in the organism at any time is depleted beyond a given point then serious disturbances must ensue. In a fatigued condition one cannot accomplish as much ordinarily as when he is refreshed. His perception, his memory, his reason, are rendered less keen and ready and accurate; his endurance in labor of any sort is lessened; he cannot perform tasks demanding the finest and most exact motor coördinations. Some pupils will become unduly tense in all their actions, while others will grow lethargic and indifferent. Restlessness and irritability will take possession of a schoolroom under such conditions.

If one is to attain the greatest efficiency, he must use his energy economically; he must avoid all practices that squander his resources. Needless motor tensions drain off the vital forces without accomplishing anything, and they must be reduced to the minimum. And first

of all by changing the state of mind which begets them. Worry, fear, self-consciousness, overscrupulousness, dissipate energy. Teachers especially need to bathe their spirits freely in the best books, the best art, the best music, and the best social life. They should keep an eye on their pupils, too, and seek to encourage in them habitual attitudes of courage and hope and joyfulness. It should be the aim to do one's work without wasteful muscular tensions. Usually tasks requiring very fine adjustments entail waste, and they should not be undertaken when unnecessary. It is the teacher's duty to banish from the schoolroom all implements, in the management of which there is demanded precise coördination, where coarser activities would answer just as well. Very fine writing or sewing or weaving and the like should be abolished. All the equipments of the school, especially the seats, must be chosen with the end in view to reduce to the lowest point the waste of nervous energy in pupils. Defective eyes must be attended to; if they are let go they will, in most cases, unfit the individual for really vigorous and efficient activity. Finally, well-poised, calm-voiced, and calm-featured teachers, who are at the same time positive and definite and, in short, *strong*, are the most important pieces of apparatus that can be placed in any schoolroom, regarded from the standpoint of the conservation of the nervous energy of pupils.

In arranging the daily programme it should be the aim

to have pupils give concentrated attention for brief periods only to the work in hand. One hour of real hard work is worth three of mind-wandering, and it is far more conservative of vital forces. Some account should be taken of the "course of power" in the day, and an effort should be made to get all school work done while the energies are at flood tide. Especial pains should be taken to so arrange the programme that it will not be necessary to hold pupils to their tasks when the waning of their powers leads to relaxed attention, so that they fall into frequent errors, and thus put themselves into an unhappy relation toward their environment.

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